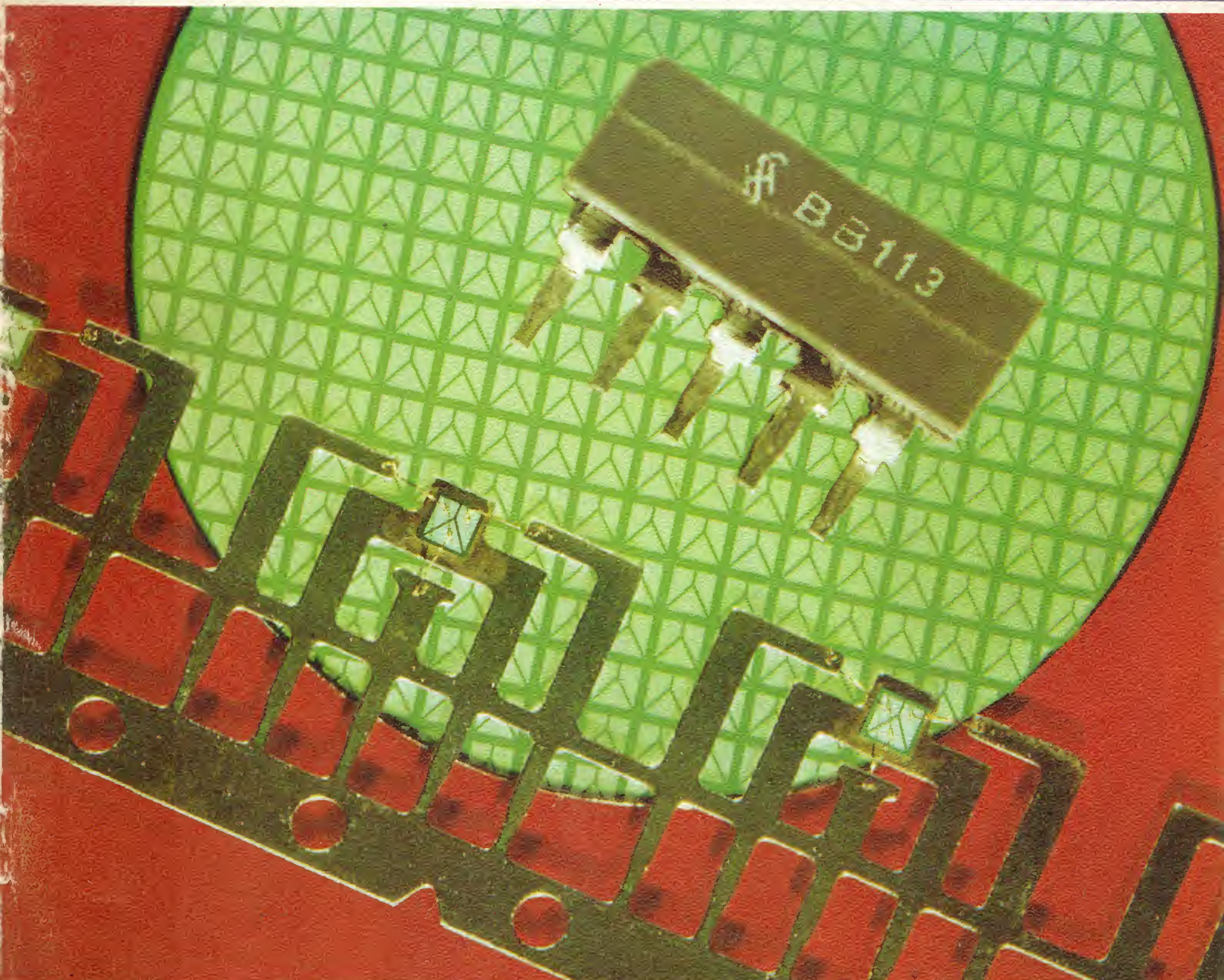
OCTOBER, 1972

AUSTRALIA'S LARGEST-SELLING ELECTRONICS & HI-FI MAGAZINE

ELECTRONICS Australia

50c*
Fiji and New Guinea 60c
Malaysia $2.50
New Zealand 60c



Registered for posting as a periodical — Category B

SIEMENS' TRIPLE AM TUNING DIODES

IC GUITAR AMPLIFIER * SIMPLE LOGIC PROBE

200MHz DFM SCALER * A CHAT WITH RAY DOLBY

ABC certified circulation in excess of 47,000

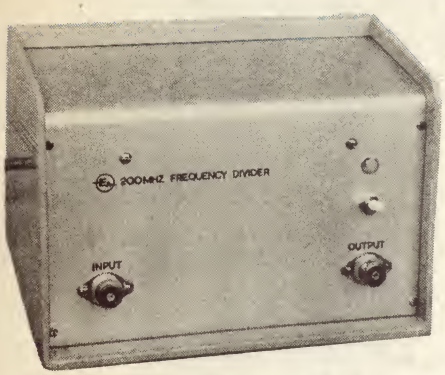
Readership in Sydney, Melbourne, Brisbane, Adelaide and Perth 211,000 (McNair National Readership Survey, May-September 1971)

ELECTRONICS Australia

Incorporating "RADIO, TELEVISION and HOBBIES" and "MODERN WORLD"

AUSTRALIA'S LARGEST-SELLING ELECTRONICS & HI-FI MAGAZINE

VOLUME 34, No 7



This low-cost instrument extends the frequency range of digital counters to beyond 200MHz. It is described in the article which starts on p36.

Most audio and hi-fi buffs have heard of the Dolby system of noise reduction, but few know of the talented audio engineer who developed it. Our story on p12 tells about his career to date.

Designed especially for practice work, this guitar amplifier uses a new power amplifier IC. See the article commencing page 22.

On the cover

Space-saving varactor diodes are steadily replacing bulky tuning capacitors in modern equipment. Our picture shows a Siemens triple AM tuning diode type BB113, placed over a wafer of the same devices, together with a strip of bonded devices before encapsulation. (Courtesy Siemens Industries Ltd)

CONTENTS — OCTOBER, 1972

world of electronics and hi-fi

projects and technical

regular features

Silicon Transistors

Choose the best technique to suit the application

- ☐ Alloy junction
- ☐ Diffused junction
- ☐ Mesa
- ☐ Planar
- ☐ Planar Epitaxial

Germanium Transistors

- ☐ Wide range of special and general purpose types.

Silicon Power Diodes

- ☐ Crest working reverse voltages to 1200V
- ☐ Average forward currents to 400A. With controlled avalanche breakdown
- ☐ Crest working reverse voltages to 1000V
- ☐ Average forward currents to 250A

PHILIPS

Integrated Circuits

- ☐ Digital DTL — CML — TTL (Interchangeable with SN74 Series) and MOS
- ☐ Linear Op Amps, Voltage Regs., Audio, Receiver types.
- ☐ DIL, Flat Pack,QUIL and TO-74/99/100
- ☐ Available to MIL Specs.

Silicon Zener Diodes

Voltage range 3.3V to 75V
Dissipation 400mW to 75W

Small Signal Diodes

- ☐ Silicon and Germanium
- ☐ Point contact
- ☐ Diffused junction
- ☐ Gold bonded
- ☐ Planar
- ☐ Planar Epitaxial
- ☐ Oxide Passivated

Silicon Controlled Rectifiers

- ☐ Repetitive peak off-state voltage to 1600V
- ☐ Crest working reverse voltages to 1600V
- ☐ Average forward currents to 250A
- ☐ Maximum junction temperatures to 125°C.

Power Transistors

- ☐ Germanium and silicon
- ☐ Dissipation to 125 watts
- ☐ Operation to 400 MHz

Transmitting Transistors

- ☐ VHF
- ☐ UHF
- ☐ SSB

High Voltage Diodes

with controlled avalanche breakdown characteristics.

- ☐ Crest working voltages to 150, 000V
- ☐ Current up to 50mA

Australia's largest range of semiconductors.

Elcoma, Australia's most experienced manufacturer in Semiconductor techniques, provide for the Industry

- ☐ **Devices suitable for all applications**
- ☐ **Comprehensive applications laboratory services**
- ☐ **Ready availability via branches in all States**

ELCOMA
Electronic Components & Materials Division of Philips Industries Limited
Sydney • Melbourne • Brisbane • Adelaide • Perth • Canberra • Hobart

PHILIPS
38.2057

EDITORIAL VIEWPOINT

Enlightenment or escapism?

It was very opportune, I think, that a major symposium at the recent ANZAAS congress held in Sydney was devoted to the important subject of communication between scientists, technologists and the rest of the community. The continuing lack of effective communication between these groups and the consequent alienation and rejection of science and technology by many people is surely a very serious problem, one whose solution would be to everyone's benefit.

In view of the importance of the problem, and considering the part which the Australian Broadcasting Commission could potentially play in helping to solve it, I was rather disturbed by some of the statements made by Dr Peter Pockley, head of the ABC's Science Unit. It would appear from his statements not only that ABC budgeting for science and technology programs is likely to be maintained at its present painfully low — and one suspects, token — level, but also that bureaucratic high-handedness, ineptitude and perhaps intrigue are effectively shackling the efforts of the Science Unit to perform its intended function.

If Dr Pockley's statements are correct, I suggest that the situation is sufficiently serious that the ABC should undertake a thorough re-examination of its programming policies, with particular attention to the question of programs dealing with science and technology. And the results of this examination should be made public, to allow the community the opportunity to evaluate the true position.

The ABC is after all financed by public money, and its utilisation of this community resource should be ultimately accountable to the public. There is also the matter of restoring the confidence of scientists and technologists concerning the willingness and/or ability of the ABC to assist with their communication problem, which I suggest has been seriously undermined.

I have always found it rather puzzling that so many of the ABC's programs seem to be planned on the basis of competing with commercial stations for ratings. This seems to be the case particularly with television programs. To me the whole idea of ABC programs competing for listeners or viewers is both unnecessary and undesirable.

Perhaps if less attention was paid to ratings, and more to providing programs designed to help the community understand the concepts and undertakings of science and technology, there might be less opportunity for protracted controversy over questions of alleged political bias.

— Jamieson Rowe

ON SALE THE FIRST MONDAY OF EACH MONTH

Printed by Land Printers Pty Ltd, of Lidcombe, NSW, for **Sungravure Pty Ltd,** of Jones Street, Broadway.
* Recommended and maximum price only.

Editorial Office
12th Floor, 235-243 Jones Street, Broadway, Sydney, 2007 Phone 2 0944. Postal Address: Box 2728, GPO, Sydney 2001.

Advertising Offices
Sydney — 8th Floor, 235-243 Jones Street, Broadway, Sydney, 2007. Phone 2 0944.
Sydney representatives:
Bill Summons, Noel Fitzpatrick.
Melbourne, — 374 Little Collins Street, Melbourne, 3000. Phone 67 7021.
Melbourne representative: Jeffrey Byrne.
Adelaide — Charles F. Brown & Associates Ltd, 429 Pulteney Street, Adelaide, 5000. Phone 23 1657.
Adelaide representative: Tom Duffy.
Perth — 454 Murray Street, Perth, 6000. Phone 21 8217.
Perth representative: Jack Hansen.

Representation
Melbourne — Sungravure Pty Ltd, 392 Little Collins Street Phone 67 7021.
Brisbane — Sungravure Pty Ltd, 78 Elizabeth Street. Phone 21 6690.
Adelaide — Sungravure Pty Ltd, 104 Currie Street, Phone 51 3502.
Perth — Sungravure Pty Ltd, 454 Murray Street. Phone 21 8217.
Newcastle, NSW — Associated Newspapers Ltd, 22 Bolton Street, Phone 2 3696.
London — John Fairfax and Sons (Aust) Ltd, Reuter Building, 85 Fleet Street.
New York — "The Sydney Morning Herald" Ltd, 1501 Broadway, New York NY 10036.

Subscriptions
Rates and order form given on page 126.

Circulation Office
9th Floor, 235-243 Jones Street, Broadway, Sydney, 2007. Phone 2 0944.

Distribution
Distributed in NSW by Sungravure Pty Ltd, Jones Street, Broadway, Sydney; in Victoria by Sungravure Pty Ltd, 392 Little Collins Street, Melbourne; in South Australia by Sungravure Pty Ltd, 104 Currie Street, Adelaide; in Western Australia by Sungravure Pty Ltd, 454 Murray Street, Perth; in Queensland by Gordon and Gotch (A'asia) Ltd; in Tasmania by Davies Bros Ltd, Macquarie St. Hobart; in New Zealand by Gordon and Gotch (NZ) Ltd, Adelaide Rd, Wellington.

NEWS HIGHLIGHTS

Domestic communications by satellite — Australia next?

The Hughes Aircraft Company of Los Angeles has sold communications satellites worth over $50 million to Canada and to the Western Union Telegraph Company in the US. A Hughes representative was in Australia in August to discuss local communications needs with relevant agencies and major users.

The Canadian system, which will be the first domestic satellite communications system in the Western world, is designed to solve many of the same problems as exist in Australia due to vast distances between outback settlements. Mr R. D. Brandes said in Sydney that the system could bring "studio quality" television and telephone services to isolated areas anywhere in Australia or New Guinea.

Such a system for Australia, Mr Brandes said, would cost about $70 million.

The Canadians have contracted with Hughes for three satellites for $30 million; two to be launched and one to be kept in reserve in case of a launch failure. They also will pay $14 million to have NASA launch the satellites into a 22,500-miles-high synchronous orbit over the equator south of Canada, and about $20 million for ground stations.

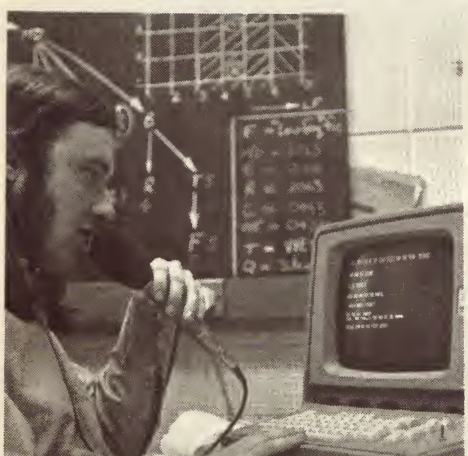
Ground stations for reception would cost about $1000 or less, depending on the size of the production run.

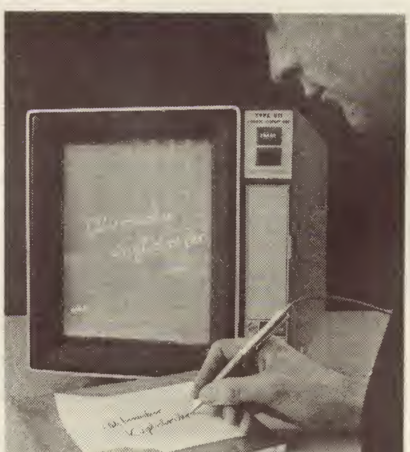
Except for the launch vehicle, almost the entire Canadian satellite system will be subcontracted to Canadian electronics companies.

The US Federal Communications Commission (FCC) in July relaxed its ban on private companies buying and launching communications satellites. Western Union Telegraph immediately ordered three satellites for over $20 million from Hughes for delivery in about 18 months. Hughes will also provide launch support services for the system, which will be the first non-government domestic satellite communications system.

Satellite systems such as those being planned for North America have a service life of about seven to ten years, with major limitations being the amount of fuel aboard to maintain a synchronous orbit and the reliability of the electronic components.

Talking — and writing — to a computer





LISTENING COMPUTER, left, recognises spoken commands and then displays answers and further instructions on a television screen. Speech recognition can easily be demonstrated with a limited vocabulary, but the problem is to develop inexpensive and reliable devices which will handle the variety of accents and inflections it may encounter. The National Physical Laboratory in England, who built the device shown above, is currently working on enlarging the machine's vocabulary. The new input device shown at right above was developed at the Siemens Laboratories in Munich for direct transmission of handwritten matter to a computer system. By use of a special electronic "ball point pen" and a thin piezo-ceramic plate as a writing base, drawings, sketches and handwriting can be passed directly to a computer as they are written.

Laser "death ray" near, but major problems remain

The US Department of Defence's spending on high energy lasers is expected to rise dramatically as researchers discover how to build CW lasers in the 100kW class. Continuous outputs over 200kW have been already reported, and if power can be increased as much as 100:1, laser weapons will be a reality.

Laser-based thermal weapons which would be almost exclusively defensive, would probably find first use in applications where large amounts of power are available, such as air defence systems on ship and shore, and eventually in large bombers as an air-to-air defence system.

Major advantages of laser weapons are the fact that the beam has minimal mass, so it can be fired in any direction without significantly disturbing the firing platform, and that its flight time is virtually zero, a factor which makes aiming and tracking systems much simpler.

But there are also major problems. Effectiveness of any weapons system depends on destructive power delivered to the target. The power density of laser beams decreases markedly with distance, which means that the amount of heating per square inch at the target will be only a small fraction of the power output of the laser.

A powerful laser beam heats the air, causing distortions and inaccuracies. At a high enough power the air will ionise, producing a plasma which absorbs and even blocks the beam to some extent.

Also, the laser beam must be focused on the target long enough to heat some part of it if the beam is to cause any damage. This presents immense tracking problems, as the beam would be focused to a spot about 1 inch in diameter on a target one mile away (if power output is to be kept within practical limits). This means the radar tracking equipment would have to be infallible in order to cause any damage.

Three types of laser are being studied as high energy sources. The most powerful so far is the **gas-dynamic** laser, which achieves excitation of the gas by squirting it through a supersonic nozzle. This laser has reportedly delivered over 200kW of continuous wave power.

The second most powerful is the **electric discharge** laser, which uses carbon dioxide gas excited by high voltage and sustainer beams of electrons. This laser will deliver nearly 100kW CW at its present stage of development.

The newest type is a **chemical** laser, which achieves pumping by means of a chemical reaction between two or more gases. It delivers about 10kW.

Even with formidable problems to be solved, American military spokesmen estimate laser thermal weapons will be in the "useful hardware" stage of development in six to ten years, with initial systems actually being deployed within ten years.

AWA selected to develop light guides

AWA will work with CSIRO and in consultation with the Australian Post Office to develop a commercially viable system of communications based on the guided light beam system announced recently by the CSIRO Division of Tribophysics in Melbourne.

The CSIRO invention uses a liquid-filled quartz fibre to overcome one of the major problems of fibre optics — that of diminishing signal strength over distance.

AWA will bring to the project experience gained during the invention of a complementary optical wave guide system.

Photo at left shows Mr Rod Esdaile, co-developer of the CSIRO system, demonstrating the transmission of information by means of the "light pipe," which is thinner than a human hair. (Light leakage from the optical fibre has been enhanced in the photo to show the position of the fibre.)

A single fibre is capable of transmitting more information than existing wide band microwave and coaxial cable systems.

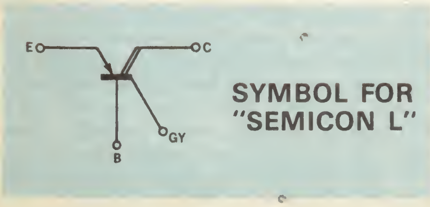
Inductance chip

Coil-less radios and TV sound IF circuits have been made as examples of a new technology made possible by "Semicon L", an integrated inductance chip developed by Mitsumi Electronic Co, Ltd, in Japan. It has opened up the possibility of complete circuit integration of circuits which have always had to be hybrids due to the use of coils.

The semiconductor inductance chip is only 0.06mm square and 0.15mm thick. It is the same in construction as a silicon planar type bipolar IC, using arsenic, boron or antimony as diffusing agents. Electrically, it is a combination of a transistor, resistors and capacitors which act as an inductance by a technique called "gyration", in which inductance is synthesised from capacitance.

Hybrid IC gyrators have been made for some time, but they required high gain and could not operate at high frequencies (over 100kHz) without phase rotation. "Semicon L" simulates inductance at comparatively low gains and at frequencies up to 10MHz.

The new IC technique (which is patented) could make a startling difference in the production of colour television sets, as about half of the circuits contain coils. If most of these coils can be eliminated it would drastically cut the size of the circuit boards. A great reduction in price, however, is not likely as fully integrated sets will cost about the same to manufacture (at least in Japan) as do the hybrid sets being made now.



Low-mass hi-fi stylus has sapphire shank

Designers of high quality phono cartridges are faced with a problem over which they have no control: the mass of the stylus itself. The mass of the present-day diamond and steel or molybdenum styli has been pared down to about 0.9mgm, but the only way to reduce it further would be to reduce its size, and this presents severe handling problems during assembly.

Further reduction in mass would have many benefits for the hi-fi enthusiast, such as less record wear, extended frequency response and greater trackability. Also, heavily modulated passages could be rendered more accurately.

Benz Mikrodiamanten Company of Andelfingen Switzerland recently patented a stylus with a nearly 10-fold reduction in mass. They have done this by eliminating the metal shank and developing a method of bonding a very small diamond tip to a .010in sapphire shank. The bond itself is claimed by the company to be stronger than the sapphire (aluminium oxide) shank.

Solid diamond styli, with a mass about half that of a diamond and steel stylus, have been available but are extremely costly. Also, mass production of solid diamond shanks is difficutlt, and the shanks must be sorted in groups of the same diameter for mounting. Aluminium oxide is easier to control and can be made to a standard diameter. The new styli are .030in long and have an extremely low mass of 0.11mgm.

The new Benz styli give superior performance at a greatly reduced cost, are easier to assemble than existing styli, and have the advantage of corrosion resistance because the diamond-to-sapphire bond is done with noble metals.

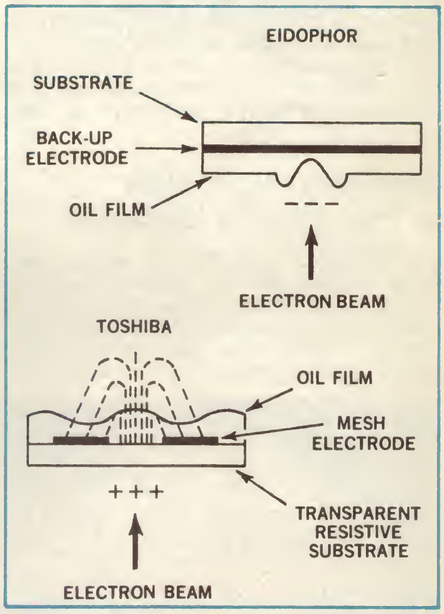
Projection TV valve has no moving parts

IC fabrication techniques are being used by Tokyo Shibaura Electric (Toshiba) to reduce the size and complexity of light valves, which form the heart of television projection systems. Basic principles of the new light valves are similar in many ways to those of the Eidophor projection system, but they do not require the large tube with internal moving parts and a vacuum pump.

A major difference is that the Toshiba tube works on a light transmission principle rather than reflection. Both use an oil film which is deformed by electrons representing picture elements. The deformities vary the refraction of light hitting the oil, and by means of a complex Schlieren optical system, the variations are focused on the viewing screen.

In the Eidophor system, very complex circuits are required to control the charge distribution and resistivity of the oil, but with the Toshiba light valve, the electron beam hits controlled-resistivity glass of the type used on image orthicons, so the oil is not degraded.

An aluminium mesh electrode is photo-etched on the surface of the glass, and in operation, a charge caused by the writing beam extends through the glass, through the open mesh, and then bends back to strike the mesh. This causes the required refractive variations in the oil film without it being directly hit by the electron beam.



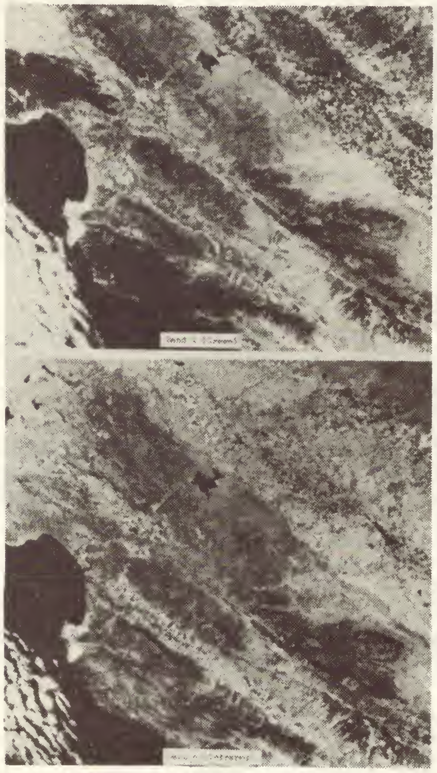
Basic principle of the Toshiba valve compared to the Philips Eidophor.

The so-called "oil" is actually a new silicon based polymer that is a hybrid between oil and highly resilient rubber. It does not need to be replaced as does the oil in the Eidophor.

Used for colour TV projection, the system would require three light sources (usually xenon arc lamps), three light valves and appropriate colour filters. Development is aimed at small-sized projection systems for small screens, rather than cinema-type applications.

NEWS

TV & scanner photos of Earth will be sold to public



SCANNER IMAGERY of California's Monterey Bay area. Top image was taken through a green filter; bottom through infrared. Bright spot at lower left is the city of Monterey. (NASA photo.)

The first Earth Resources Technology Satellite (ERTS-1), launched on July 23, has been mapping the world with varying degrees of success. The multispectral scanner has been returning excellent data and photographic reproductions of the scanner imagery taken over North America are available to the public by mail order.

Problems with power surges in August caused the shutting down of one of the two video tape recorders and the return beam vidicon (RBV) camera system until the cause of the electrical problems can be traced. The faults are not considered serious.

NASA has announced that photos are available to the general public in the US and other countries from six imagery dissemination centres in the US. Prices vary from US$1.25 for a 70mm black and white contact print to US$27 for a 40 x 40in colour transparency.

Each of the dissemination centres specialises in a different type of data, such as weather, agricultural, remote, sensing, etc. The address for earth resources photos is: EROS Data Centre, 10th and Dakota Av, Sioux Falls, South Dakota 57198. Information and prices are available on request.

Photos of Australian terrain are not yet available, but when they are they will be sold by the National Mapping Division of the Department of National Development in Canberra. First photos should be available in a few weeks time.

ERTS satellites and their camera systems were described in the October 1971 issue of "Electronics Australia."

Fowler wins IREE award

Mr Alan M. Fowler — Principal Engineer, Lines and Data Systems Section of the Australian Post Office — was awarded the "Norman W. V. Hayes Memorial Medal for 1971" at a general meeting of the Melbourne Division of the IREE held in the National Science Centre, Parkville, on Tuesday, 8th August.

The bronze medallion, the premier award of the IREE, is intended as a perpetual tribute to the late Mr Hayes — a former Chief Engineer of the Post Office and ex-President of the Institution.

The award is made annually for the most meritorious paper published in the "Proceedings" of the Institution and this year's award was made on the recommendation of the Institute of Electrical and Electronics Engineers of America for his paper: "Radio Frequency Performance of Electroplated Finishes".

This is the second major IREE award won by Mr Fowler who shared the IREE-Macquarie award with Mr E. J. Kemp in 1963, also for a paper of outstanding merit. Mr Fowler has been active in the affairs of the Institution for many years and is currently Deputy Chairman of the Melbourne Division.

Automatic airliner flight — from liftoff to touchdown

A Lockheed L-1011 Tristar jetliner has flown across the US under completely automatic conditions. Test pilots did not touch the control column of the big Rolls-Royce powered trijet from the time the brakes were released on a California runway until after its automatic landing in Virginia.

The flight was made with a new automatic flight control system developed for the Tristar by Lockheed, Collins Radio Co and Lear-Seigler. The system is capable of a fully automatic landing by use of the airport's instrument landing system radio beams, with the pilots simply sitting back and watching the instruments until after touchdown.

OSO 7 warned world of huge sun storm

Sun storm region, upper right, 100,000 miles (160,000km) across, passed over the west limb of the sun in August. Two days' warning of the most intense storm in several years was given by NASA's orbiting Solar Observatory (OSO 7). Preliminary results show the storm produced the highest energy radiation ever recorded from the sun. It created waves in the Earth's magnetic field and caused disruption of communication systems around the globe. OSO 7 can follow a storm before it appears to ground-based observatories.

APO will install Toshiba mail-sorting machines

Following the examination of world-wide tenders, the Australian Post Office has placed an order valued at $1.5 million with Mitsui & Company (Aust. Ltd) Melbourne, for mail processing equipment used to prepare mail for postmarking.

Fifteen machines made by Toshiba, of Japan, have been ordered and will be installed within the next 12 months in mail processing centres in Perth, Adelaide, Melbourne, Brisbane, Canberra and Sydney.

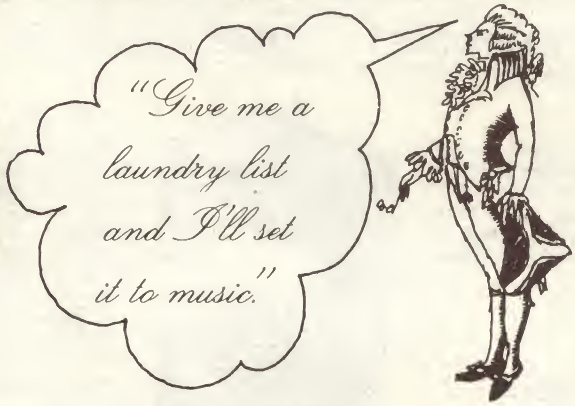
The machines cull out over-sized letters, and packets, letters not carrying stamps, and any that contain hard objects such as keys. They then face up the remaining letters and postmark them prior to sorting for destination.

Each machine is capable of processing mail at up to 25,000 items an hour and, to prevent any possible damage to mail, will stop immediately with an automatic fail-safe technique if any jamming occurs.

The new machines will reduce operational man-hours, eliminate some of the more tedious processing functions and, greatly expedite the movement of mail particularly during peak periods. The decision to purchase these machines followed exhaustive tests on a prototype unit under normal traffic conditions.

TEAC's AN-60, AN-80 and AN-180 Noise-Reduction Units.

TEAC AN-60



If Rossini were alive today, he would set their specs to music.

Rossini once made this boast and could probably have delivered. But a recording of the music on the best of today's cassette or reel-to-reel machines with their inherent noise and hiss could never capture the clean, crisp sound of the Rossini laundry list.

With the introduction of TEAC's AN-180 Dolby* Noise-Reduction Unit, Rossini's Laundry Largo and just about anything else you record will have the same brilliance and luster as the original.

Our Dolby circuit removes machine and tape noise with such thoroughness that there is a signal-to-noise ratio improvement of 3 dB at 600Hz, rising to 5 dB at 1000Hz and 10 dB at 4K Hz and above.

Because we manufacture the ICs used in our Dolby circuit to extremely tight tolerances, ours operates at distortion levels of less than .3% — lower than many competitive units. So you see there is no question that you should have a TEAC Dolby Noise Reduction Unit.

We designed the deluxe AN-180 not only to Dolbyize fine decks, but to afford them features they might be missing.

TEAC
AN-80

It's actually a simultaneous record-playback control center with its own record and playback amps. It has built-in mike and line preamps that maintain mixing capability, or add this capability to recorders not so endowed.

TEAC
AN-180

It has large professional-type VU meters for Dolby level setting as well as record/playback level indicators. AN-180 also incorporates such features as an internal 400 Hz, 100 Mv oscillator level controls, source/tape monitoring and a multiplex interference filter.

Even without Rossini to write a setting for the AN-180 specs, they make such beautiful music.

- Frequency Response, 20-15,000Hz ± 5 dB • Increased SN Ratio, 10 dB at 10,000Hz • Harmonic Distortion, below 0.3%
- Signal to Noise Ratio, better than 65 dB • Channel Separation, better than 55 dB

If you just need the best no-nonsense Dolby with none of the frills, ask your dealer about the TEAC AN-180 and AN-60

*Dolby is a trade mark of Dolby Laboratories, Inc.

TEAC® A Sound Idea If you'd like to know more write to us for the TEAC Catalogue, price list and franchised dealer.

Sole Australian Distributors: Australian Musical Industries Pty Ltd., 155 Gladstone St., South Melbourne Vic. 3205 Ph. 69-7281
619 Pacific Highway. St. Leonards, NSW 2065 Ph. 439-5752

AMI 143

INSTROL *SLASHES A.D.C. PRICES*

ADC STEREO CARTRIDGES — AMERICA'S QUALITY CARTRIDGE

ADC 220X . . . $17.00

ADC 220X. Type: Induced Magnet; **Output:** 6 mV at 5.5 cms / sec. recorded velocity; **Tracking Force:** 1 to 2½ grams; **Frequency Response:** 10 Hz to 18 kHz +3dB; **Channel Separation:** 20dB from 50 Hz to 10 kHz; **Compliance:** 20 x 10-6 cms / dyne; **Spherical Stylus Tip Radius:** 0007" **Vertical Tracking Angle:** 15°.

ADC 10E mk4 . . . $51.00

Type: Induced Magnet*
Output: 4 mV at 5.5 cms / sec. recorded velocity
Tracking Force: 7 gram
Frequency Response: 10 Hz to 20 kHz ± 2 dB
Channel Separation: 30 dB from 50 Hz to 12kHz
Compliance: 35 x 10-6 cms / dyne
Elliptical Stylus Tip: Contact radius: .0003"; lateral radius: .0007"
IM Distortion: Less than ½"% — 400 & 4000 Hz at 14.3 cms / sec. recorded velocity
Vertical Tracking Angle: 15 degrees
Recommended Load Impedance: 47000 ohms nominal

ADC 220XE . . . $22.00

ADC 220XE. Type: Induced Magnet; **Output:** 6 mV at 5.5 cms / sec. recorded velocity; **Tracking Force:** 1 to 2½ grams; **Frequency Response:** 10 Hz to 18 kHz ± 3dB; **Channel Separation:** 20 dB from 50 Hz to 10 kHz; **Compliance:** 20 x 10-6cms / dyne; **Elliptical Stylus Tip Radii:** Contact radius .0003". Lateral radius .0007"; **Vertical Tracking Angle:** 15°.

ADC 550XE . . . $30.00

ADC 550XE. Type: Induced Magnet; **Output:** 5 mV at 5.5 cms / sec. recorded velocity; **Tracking Force:** ¾ to 2 grams, **Frequency Response:** 10 Hz to 20kHz + 2 dB; **Channel Separation:** 20 dB from 50 Hz to 12 kHz; **Compliance:** 35 x 10-6 cms / dyne; **Elliptical Stylus Tip Radii:** Contact radius .0003". Lateral radius .0007"; **Vertical Tracking Angle:** 15°.

SPECIAL INTRODUCTORY ADC OFFER . . . SAVE $ $ $ $

J. H. TURNTABLE (complete) This outstanding turntable value consists of:—

(A) J. H. TURNTABLE	Belt drive, synchronous motor, unmeasurably small rumble, wow and flutter of better than 0.04%, negligible hum radiation, with 12" diameter of platter.
(B) LUSTRE ST510D ARM	A high precision universal arm, stylus pressure is adjusted by calibrated counterweight. Oil damped cueing lift is fitted.
(C) A.D.C. 220X	Magnetic cartridge. Tracking force 1½ to 3 grams, extremely linear and smooth frequency response.
(D) INSTROL 45 Stand + Hinged Perspex Cover	This acoustically sprung player stand is available in either oiled teak or walnut, with hinged, moulded perspex cover.

ALL THE ABOVE FOR ONLY $105.00 Completely assembled in carton

COMPLETE HI-FI CATALOGUE & PRICE LIST . . . ONLY 50c

Contains full specifications, retail pricing and discount pricing on the following items:—
Turntables, Player Stands and Perspex Covers, Cartridges and Styli, Amplifiers, Amplifier Kitsets, Tuner Kitsets, Separate Speakers, Speaker Systems, Speaker Enclosures, Speaker Kits, Tape Decks, Tape Recorders, Record Storage Cabinets and Kits, Equipment Cabinets (Built and Kits) for Hi-Fi, Hi-Fi Accessories, Guitar Amplifiers and Guitar Speaker Systems (Built and Kits), Technical Books, Instrol Products. etc.

Please send me your complete hi-fi catalogue and price list. I enclose herewith postage stamps or money order to the value of 50c. I understand that the 50c will be refunded on my first purchase.

NAME ....

ADDRESS ....

....P.C...........

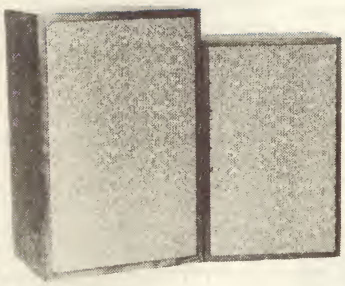
E210

INSTROL

SPEAKER SYSTEMS

All the systems below are available in kit form. The cabinet kits come in either unpolished Queensland Maple veneer or unpolished teak veneer. All kits are complete, and include speakers, crossover networks (where applicable), cabinet kits, grille cloth and innerbond.

MAGNAVOX 8-30 system
at reduced prices



Featured in "EA" Jan 1971. It handles 30 watts RMS, FEATURES A NEW HIGH PERFORMANCE 8" SPEAKER, TWO 3" TWEETERS, AND IS AVAILABLE IN CABINET 20⅞" x 12⅞" x 8⅞" (1 cu ft) or 23⅞" x 15½" x 10⅞" (1.6 cu ft). Available in teak or walnut veneer.

COMPLETE SYSTEM

Kit of Parts	**$42.00** (1 cu ft) **$52.00** (1.6 cu ft)
Built and Tested	**$55.00** (1 cu ft) **$65.00** (1.6 cu ft)

SEPARATE COMPONENTS

Enclosure kit (1 cu ft)	**$16.50** (walnut) **$17.50** (teak)
Enclosure Kit (1.6 cu ft)	**$26.00** (walnut) **$28.00** (teak)
Built Enclosure (1 cu ft)	**$29.00** (walnut) **$30.00** (teak)
Built Enclosure (1.6 cu ft)	**$38.00** (walnut) **$40.00** (teak)

ECONOMY BASS REFLEX SYSTEM

"E.A." design, Nov. 1970, consists of a Rola C8MX speaker. In cabinet 20" x 11" x 9". Ideal for low wattage.

COMPLETE SYSTEM

Kit of Parts (teak or maple)	**$26.00**
Built and Tested (teak or walnut)	**$42.00**

SEPARATE COMPONENTS

C8MX speaker only	**$9.50**
Enclosure kit	**$17.00** (maple), **$17.50** (teak)
Built Enclosure	**$30.00** (maple), **$32.00** (teak)

WHARFEDALE SPEAKER SYSTEM KITS

The Wharfedale Super Linton, Melton and Dovedale 111 are now available as build-yourself kits, featuring INSTROL quality cabinet kits in choice of maple or teak veneer.
The Super Linton kit employs an 8" and 3" speaker, frequency response 40-17,000Hz, cabinet 21" x 11½" x 9½". 15 watts RMS. The Melton kit employs a 12" bass and a tweeter, cabinet 22¾" x 13" x 10", 25 watts RMS.
The Dovedale III kit employs a 12" bass, 5" mid-range and 1" tweeter. Cabinet 28" x 15½" x 10". 35 watts RMS.

COMPLETE SYSTEM

Super Linton kit (Unit)	**$52.00**
Melton kit (Unit 4)	**$93.00**
Dovedale III kit (Unit 5)	**$128.00**

SEPARATE COMPONENTS

Unit 3 encl. kit	**$15.50** (maple), **$16.00** (teak)
Unit 4 encl. kit	**$26.00** (maple), **$28.00** (teak)
Unit 5 encl. kit	**$35.00** (maple), **$37.00** (teak)

INSTROL and SEAS COMBINE to present 2 NEW speaker systems the BROADWAY 201 and BROADWAY 251

BROADWAY 201 — This system features the SEAS wide range 8" speaker, 21TV.GD, in your choice of teak or walnut enclosure. The attractive cabinets, which feature bevilled fronts, measure 16⅞" x 11" x 9".

BROADWAY 251 — This system uses the 25TV.ED, a 10" wide range speaker by SEAS, in teak or walnut cabinets. Featuring bevilled fronts, the enclosures measure 21" x 12" x 11½".

COMPLETE SYSTEM

Kit of Parts (Broadway 201)	**$26.00**
Kit of Parts (Broadway 251)	**$33.00**
Built and Tested (Broadway 201)	**$36.00**
Built and Tested (Broadway 251)	**$46.00**

SEPARATE COMPONENTS

Broadway 201 encl. kit only	**$14.00** (walnut) **$15.00** (teak)
Broadway 251 encl. kit only	**$19.00** (walnut) **$19.50** (teak)
8" SEAS (21 TV.GD) speaker only	**$12.50**
10" SEAS (25 TV.ED) speaker only	**$14.50**

INSTROL
HI-FI & ELECTRONICS CENTRE
91A YORK ST., (between King & Market Sts.)
SYDNEY, N.S.W. 2000. Phone 29 4258

Please send me the following speaker systems and/ or turntable systems and/ or perspex covers. These will be sent by road transport or passenger rail, freight payable on receipt of goods. Cartridges will be sent freight free.

....at $...............

....at $...............

....at $...............

Enclosed my money order/ cheque for $ ....

NAME...

ADDRESS..

.... P.C. ....

E210

NEWS HIGHLIGHTS

Record length ducts under lake

The longest uninterrupted stretch of telephone cable ducts yet installed in Australia has been laid under Canberra's Lake Burley Griffin.

The lake crossing measures 1730ft from shore to shore, and the distance between the manholes constructed at the extremeties of the ducting is 1780ft.

The purpose was to provide additional links from the city area to such suburbs as Deakin, Woden and Tuggeranong.

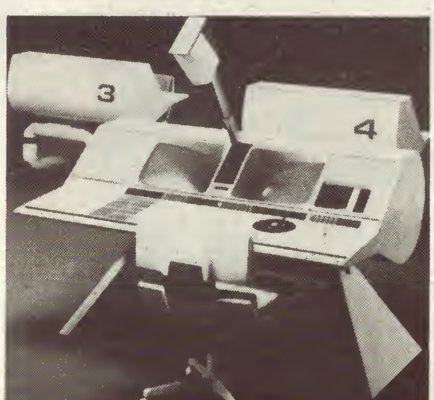
Photo above shows the sixteen runs of 4in PVC ducts, secured together in assemblies weighing more than 4½ tons, entering the water. The smooth bore and minimal friction of the plastic pipes, manufactured by Vinidex Tubemakers Pty Ltd, made it possible to pull telephone cables of such length through the ducts from shore to shore.

Though a major undertaking, with difficulties that caused the work to take longer than expected, it was more practical and more economical to put the cable ducts under water than to skirt the lake by land.

Also, APO planners recognised that crossing the lake with lighter cables protected by ducts would save thousands of dollars compared with laying heavily protected submarine cables.

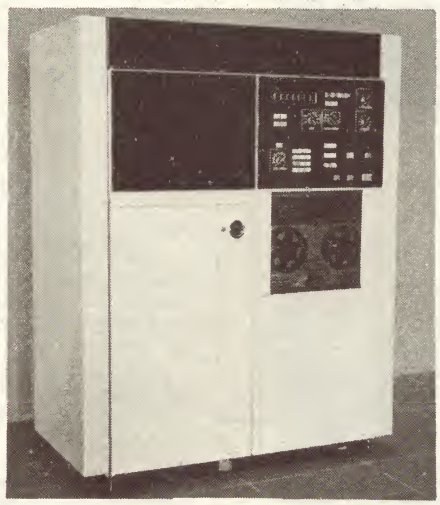
Teacher's desk of the future

A "Teacher-aiding Electronic Learning Link", or TELL, is a two way audio-visual link between a teacher's desk equipped with video cartridges and pupils' desks equipped with monitors. The brainchild of Philips Industries design centre, TELL also provides a TV camera on the teacher's desk so he or she can point at something in a videotape picture or transmit book pages. A push button panel enables the student to respond to programmed instruction and to reply to the teacher verbally.



DATAVISION D-2400 CHARACTER GENERATOR is a flexible and inexpensive means of generating supplementary character information for display on television screens. Large, 32 scan-line high characters can be displayed in up to eight rows with 16 characters in each row. The D-2400 is now marketed in Australia by Plessey Electronics.

Softwired numerical control



General Electric USA has just released the new 8500 softwired numerical control system. The new series is capable of operating machines with up to four axes in a single machine configuration and eight axes in a machine cluster.

Enquiries to Australian General Electric Ltd, at 86-90 Bay Street, Ultimo, NSW 2007.

Indian import policy hits IBM renovation program

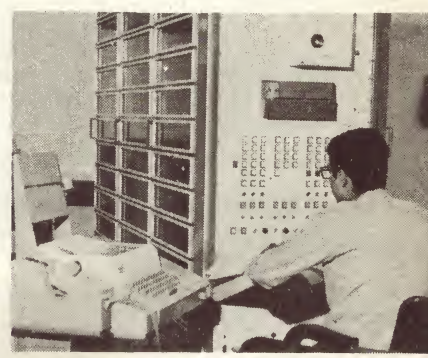
The Government of India has announced new guidelines for the import and manufacture of all types of computers and other electric equipment. The policy aims at developing indigenous manufacturing programs.

Immediately, this will affect the operations of IBM as it has been decided not to permit any manufacturing programs based even on the renovation of old machines. While there is no question of permitting 100 per cent foreign equity participation in any future manufacturing program, even majority foreign equity holding will be permitted only on the condition that 100 per cent of the company's products are exported.

The Government-owned Electronic Corporation of India Ltd at Hyderabad (ECIL) is being backed to manufacture sophisticated computers. ECIL has the know-how and need not depend on foreign technical tie-ups.

The policy towards foreign companies like IBM, who are engaged at present in a limited program of renovation of old equipment which was discarded abroad has been reviewed by the government. It is now felt that these machines, after being brought into India at a very low cost and renovated, are being sold or leased at very high prices. The Government has decided to stop this practice forthwith.

At the same time, the government is proposing to meet computer requirements by building large regional computer centres. The first centre is to be set up shortly at the Indian Institute of Technology, Madras.



INDIA'S OWN COMPUTER, the TDC-12, is manufactured by the Electronic Corporation of India Ltd (ECIL).

For the Madras regional computer centre, the Federal Republic of Germany has given two million deutsche marks for acquisition of a large computer system. For the other centres at New Delhi, Bombay and Bangalore, the Government has sought financial assistance from the United Nations Development Program.

Private parties have been asked not to import computers. All such users have been asked to meet their in-house requirements through computers available in the Indian market. Computers have been placed in the list of expensive items of import, and any import will be allowed only if it is in the national interest.

from N. Viswanath, New Delhi

Sizzling!

the only word to describe the extraordinary performance of the new Wharfedale "Denton" and "Linton" compact speaker systems.

Building effective compact speaker systems requires technical *"know-how"* and *experience* — and that's where Wharfedale really shines. For over forty years Wharfedale has been Britain's leading manufacturer of high quality wide range loudspeakers; Wharfedale advances in technology are very obvious in the all-new "Denton" and "Linton"

Two models of each unit are available . . . a two way system with an entirely new 8″ bass reproducer and a 2″ tweeter, and a three way system which specifies a 4″ mid-range speaker in addition, to add further reinforcement in the *"presence"* frequencies.

A long throw voice coil is used in the bass speaker to provide restraint-free lower registers and the new 2″ tweeter is the result of intensive Wharfedale research — high frequencies are smooth and satisfying. Large magnet structures offer greater sensitivity.

Now examine closely these brief specifications:

DENTON 2.

Size: 14″ x 9¾″ x 8¾″./Frequency response: 60-16,000 Hz. ± 3 dB./Power rating: 20 watts DIN./Speaker complement: 8″ bass speaker, 2″ tweeter./Crossover frequency: 1,400 Hz./Finish: Oiled teak or polished walnut.

LINTON 2.

Size: 19″ x 10″ x 9½″./Frequency response: 55-17,000 Hz. ± 3 dB./Power rating: 20 watts DIN./Speaker complement: 8″ bass, 2″ tweeter./Crossover frequency: 1,200 Hz./Finish: Oiled teak or polished walnut.

LINTON 3.

Size: 19″ x 10″ x 9½″./Frequency response: 55-17,000 Hz. ± 3 dB./Power rating: 25 watts DIN:/Speaker complement: 8″ bass, 4″ mid-range, 2″ tweeter./Crossover frequencies: 1,100 and 4,000 Hz./Finish: Oiled teak or polished walnut.

DENTON 3.

Size: 14″ x 9¾″ x 8¾″./Frequency response: 65-17,000 Hz. ± 3 dB./Power rating: 25 watts DIN./Speaker complement: 8″ bass, 4″ mid-range, 2″ tweeter./Crossover frequencies: 1,100 and 4,000 Hz./Finish: Oiled teak or polished walnut.

WHARFEDALE WHARFEDALE ***FINEST BRITISH DESIGN.***

Come and hear the difference Wharfedale experience makes. Call at your nearest franchised Bleakley Gray dealer — ask for a no-obligation demonstration. Imagine how well they'll sound at home . . . *then find out how little they cost!*

Australian National Distributors:

Bleakley Gray Corporation Pty. Limited.

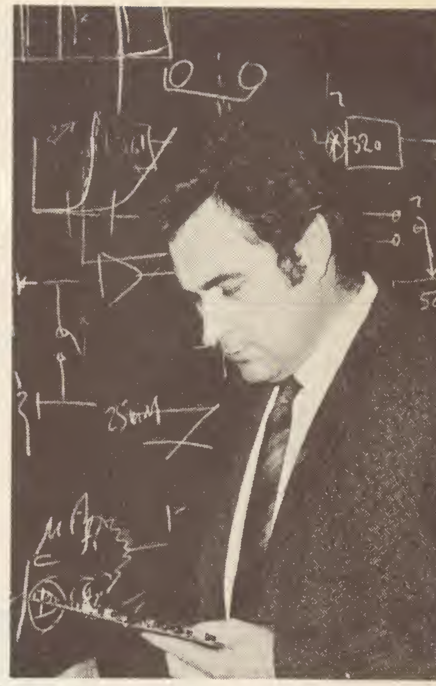
Head Office: 28 Elizabeth St., Melbourne, Vic. Tel. 63 8101 * Telex: 31904
Sydney Office: 53 Victoria Ave., Chatswood, N.S.W. Tel. 40 4522*
Canberra Office: 25 Molonglo Mall, Fyshwick, A.C.T. Tel. 95 6526
Adelaide Office: 301 South Terrace, Adelaide, S.A. Tel. 23 6219

INTERSTATE REPRESENTATIVES:
N.T.: Pfitzner's Music House, Smith Street, Darwin. Tel. 3801. Q'land: Sydney G. Hughes, 154-158 Arthur Street, New Farm, Brisbane. 58 1422 Tas.: K. W. McCulloch Pty. Ltd., 57 George Street, Launceston. 2 5322. W.A. Athol M. Hill Pty. Ltd., 1000 Hay Street, Perth. 21 7861.

SG-WNP-4

A chat with Ray Dolby

by SYLVIA MARGOLIS in London.



The name of Dolby is rapidly becoming a byword in audio circles and the term is even finding itself in the category of household words — at least in households which take pride in their tape recording equipment. The name, of course, is that of the renowned system for noise reduction. It is also the name of Dr Ray Milton Dolby, the American engineer who first devised and now holds the patent for the noise-abatement technique.

Little is known of Ray Dolby in the US because he has chosen to establish his remarkable organisation, Dolby Laboratories, in London. The factory is small by American standards, a four-story modern building on a busy road 4 miles southwest of down-town London, at Clapham.

Ray Dolby was born in 1933, the son of a real estate salesman who had a passion for all things mechanical. In regard to his father Dolby told me, "Having the father that I had was the most important thing that happened to me. He inspired my interest in electricity, electronics and photography but, just as important, he taught me always to be sceptical of any kind of established wisdom! He provided my imagination. Then there was my mother — she provided the discipline. She taught me to finish one project before I began another."

Hard work was part of Ray Dolby's life, beginning with early childhood. Before he was 11 years old he was mowing neighbours' lawns at 25c an hour, in the tradition of the all-American boy. During the summers he was 11, 12 and 13 he worked on a celery ranch. The work was concerned with irrigation, which suited Ray completely. He recalls, "I liked irrigation because you would let the water in at the top end of the row and then go down to the bottom of the row and wait about ten minutes. It happened that in the loft of the ranch pumproom I found a windfall — piles of copies of Popular Mechanics and Scientific American, some going back to the beginning of the century which I would read in that ten minutes."

Not only did Ray earn $200 to $300 a summer to finance his hobbies, but those old magazines were a catalyst for his hobbies and work of the present day. Very early on he started to work with electronics and electricity. He built the usual kind of TRF radio sets, 10W amplifiers and phonographs and had his own darkroom, where he and his father made prints and enlargments and also experimented with emulsions, putting photographic images onto any arbitrary surface.

Ray went to Sequoia Union High School on the San Francisco peninsula. It was a good school for Ray, particularly oriented for technically inclined children. Ray, one of 3,000 students, took the school's excellent courses in electronics, electricity, physics and chemistry, as well as a general college-preparatory course.

During these years he had never been tempted to take a radio amateur course, although he did play around a bit with Morse code. He organised an electronics club with the neighbourhood kids. It is still vivid in his memory: "I used to teach them about electricity and electronics, although sometimes I had to learn the next day's lesson the night before, to keep ahead . . ."

During the summers he washed dishes and worked as a building labourer, until the summer he was 16 years of age. By then he was the technician for the Sequoia High School projection crew. The work involved keeping the school's Bell & Howell and Ampro equipment in good working condition. Occasionally somebody inquired if the school equipment could be hired for an outside performance. Ray went with the installation, as engineer and projectionist, at $5 per engagement.

One such inquiry came in the spring of 1949 from a man called Alex Poniatoff, who wanted a movie run for the Mental Health Society of San Carlos, California. The projectionist would receive $5 plus a free meal. The performance was to be at a plant called Ampex, where about 20 people worked.

After the film had been shown, Ray expressed interest in the Model 200 tape recorder to Mr Poniatoff. He recalls the conversation: "I didn't know who Alex was. I just wanted a demonstration. I'd heard hi-fi before but only half-baked hi-fi. This was the real thing, for the first time. I was thrilled and tremendously impressed. I asked Alex what his job was at the plant and was quite floored when he said, 'This is my company.' I'd never met any company owners before."

(Ed. note: A. M. Poniatoff was a Russian immigrant to the US who named his company AMPEX after his initials, plus "ex" for excellence. He developed the first practical broadcast-quality audio tape recorder, the Model 200, in 1946 after experimenting with the Magnetophone, developed during WW2 by Telefunken in Germany. Radio studios at first refused to use Ampex's tape recorder because of the fear of tape breakage during a broadcast, but were pressured into its use by Bing Crosby, on whose show it was first used.)

Ray agreed to Alex's suggestion that he work for Ampex some time. The opportunity came that July. Things weren't easy for Ampex in those days and they couldn't take on as many people as they wanted. The Company's Chief Engineer was doubtful about taking on a school kid but Alex persisted and Ray was allowed to join the engineering department. His first job was to make several hundred standard alignment tapes for the Model 200.

Ray Dolby examines some of the consumer products incorporating the Type B Dolby system. Although he is American and most of the licensees are American companies, he prefers to have his headquarters in London.

Reprinted from Electronics Illustrated, copyright c, May 1971, Fawcett Publications Inc, New York.

"There is still room for the individualist, the visionary, the loner, in technological invention", says Dolby. At left, he works out a circuit problem on the blackboard in his office.

He put in a year at San Jose State College, studying electrical engineering. At the time he seemed to be spending more hours a day working for Ampex, part-time, than as a full-time student.

At Ampex, a man named Charles Ginsburg was just starting work on a brand new project — the design of a videotape recorder. Not much hardware had yet been built when Ray joined the project. The first experiments the two engineers collaborated on were designed to produce some kind of rotary-head device which could record and reliably reproduce. They started off in a fairly modest way, with a 3,600-rpm motor and three heads with 2-in tape. "We came up with a frequency response of 100kHz or so." Ray recalls. "We moved on from there, refining techniques, adding a fourth head, developing methods for switching from head to head, working out modulation systems, both AM and FM and also servosystems."

Ray had to leave Ampex for Army service in the middle of the project but he followed the monochrome project right through to its conclusion on his return.

Two years in the US Army ensued, in which he attained the rank of Corporal and ended up as an instructor of electronics, maths and physics in St Louis.

After the Army he went back to San Jose State College, again working intensively part-time for Ampex, did another year at San Jose, then two years at Stanford University where he gained his Bachelor's degree and won a Marshall Scholarship to Cambridge University in England.

His idea at first was to do an English Bachelor's in electrical engineering, but Ray quickly realised that he had already covered most of the relevant material. His supervisor advised him to go straight into research.

He spent six years at Cambridge, the last three as a Research Fellow at Pembroke College and as a researcher at the world-famous Cavendish Laboratory. During his last year there he was a Consultant to the UK Atomic Energy Authority. At Cambridge he completed his dissertation on long-wavelength X-ray microanalysis and received his PhD (hence Dr Dolby).

In 1963, Ray Dolby went to India. Why? "I knew I had to get out of Cambridge because I knew that if I stayed there very much longer, I would stay forever," he says. "It's that kind of place. But I knew also that I wanted to travel. While I was in England I had covered most of Europe. So I went on this United Nations job with the vague idea of fulfilling my perpetual urge to see the rest of the world, to taste other cultures. It was a kind of open-ended thing. I knew that at some point I had to start my own company. The idea of starting on my own crystallised while I was in India. I got the idea for the System in India. I had to do a lot of driving and I used to think and calculate and work out problems during this time.

"I'd been concerned with recording problems and signal-to-noise ratio early on, particularly at Ampex. Indeed I did devise a noise-reduction system there. At Cam-

Ray Dolby . . .

bridge I was working on the problem of extracting signals from a very noisy background. This involved signal statistics and devices for optimising signals in any particular situation. This work doesn't apply particularly to sound recording. Remember I was working on X-rays at the time. But I was also interested in tape recording at Cambridge."

At Pembroke, which is one of the younger Cambridge colleges, only about 600 years old, he had a room which he turned into a kind of studio. He had permanent mike lines over to the College Chapel, so he could record some of the magnificent music coming from there. There was an excellent signal-to-noise ratio in the lines directly from the Chapel, but he could hear immediately the deterioration when he switched to the output of the recorder.

About this tape phenomenon Dolby says, "This bothered me. The before-signal was so glorious, but even with a good machine, a 7½ips two-track Ampex, the result was awful. This spurred me to thinking about recording systems. It took about a year of concentrated thinking in India, during which I re-invented most of the existing noise reduction systems. Suddenly it struck me that all these distortion problems would disappear if one could deal with the high-level signals separately from the low-level signals."

Ray Dolby worked in India for two years, as a UN Adviser to the Central Scientific Instruments Organisation. In 1965 he drove overland back to England (take a look at a map to see what that entails!) in the Volkswagen he still drives.

Dolby, nearly 38 years old now, is a large, attractive young man, looking, by haircut and dress, already more British than American although he returns to the US about four times a year. His parents still live in San Jose, California. He's remarkably articulate for a scientist, gesticulates a lot with his fine hands, yet there's a listening, aware quality about him, an ability to appreciate a situation, a sensitivity and an enormous amount of gentle charm.

Four years ago he married a beautiful German girl called Dagmar, whom he met at Cambridge when she was there studying English. They live in an elegant apartment on the top floor ("it was the old servants' quarters, I guess") of an old house in Chelsea, which is one of the nicest parts of London to live. There are modern, abstract paintings and lots of souvenirs from India.

Of one thing Ray Dolby is certain. "There's always room for the individualist, the visionary, the loner, in technological invention. The loner has a great advantage over the closetted employee of a big corporation, because he can make the quick decision that, in a big company, could never be decided without days of committee meetings. The loner has the agility of mind, the freedom of movement, to decide and to act without lengthy deliberation at every stage.

His advice to the young experimenter is to develop and maintain a healthy scepticism about established wisdom. "Established technology is like big corporations — it gets bogged down with its own weight," he says. He thinks that the young experimenter is much more likely to make that big contribution to progress if, from the earliest stages, he questions what he is being taught by his teachers and lecturers, even by the books he is reading.

"And the most important things that have happened to you?", I asked him. There was a very long pause. "As I said — being born to the parents I was born to. But then, also, there was Alex Poniatoff, who wanted only to hire a movie installation. He got himself a school kid to whom he gave the opportunity to work with enlightened and talented engineers before that kid had the disadvantage of being corrupted by formal education."

Production near on Dolby Type B integrated circuits

Signetics Corporation, the American IC manufacturer, has announced that its new Type B integrated circuit for use by Dolby licensees will be available shortly for evaluation. Signetics will be the sole supplier of the IC for six months from date of first production deliveries. After six months information will be made available from Dolby Laboratories to other IC manufacturers who wish to enter the market.

Since the addition of the Dolby noise reduction system to hi-fi equipment involves addition of a considerable amount of complex circuitry, and therefore extra cost, its success in the consumer area will largely hinge on the use of reasonably priced ICs.

Signetics' IC will be a 16-pin dual in-line package. Each channel of the basic processor will consist of the IC and about 13 external components (see block diagram). No variable gain or law potentiometers will be needed, so that alignment and testing times will be reduced.

The circuit will be powered from an unregulated supply of between 10 and 24 volts and will draw a current of about 20 mA. Input and output levels and impedances will be similar to those of the current "580mV" switchable processor using discrete components (A2C 537). The input sensitivity will be 30mV at a high impedance; the output level will be 580mV.

The input and output levels and impedances will be such that the IC will replace level-raising and output amplifiers in addition to providing noise reduction.

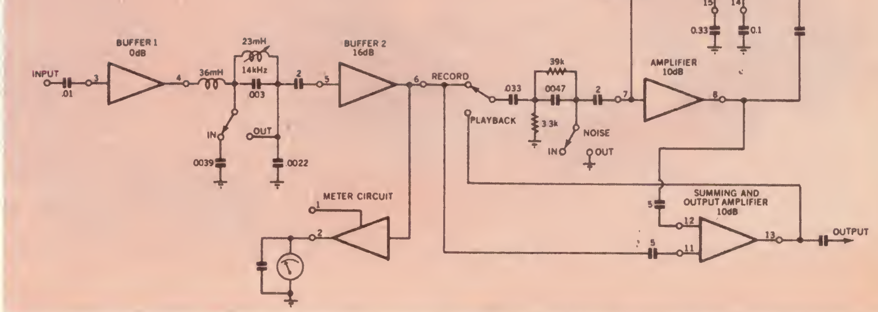
For example, each channel of a basic tape deck will only require, in addition to the integrated circuit and its associated components, an equalised playback preamplifier capable of producing an output of 30mV, an equalised record amplifier with an input sensitivity of about ½ volt, and a bias and erase oscillator. No further output amplifier will be necessary.

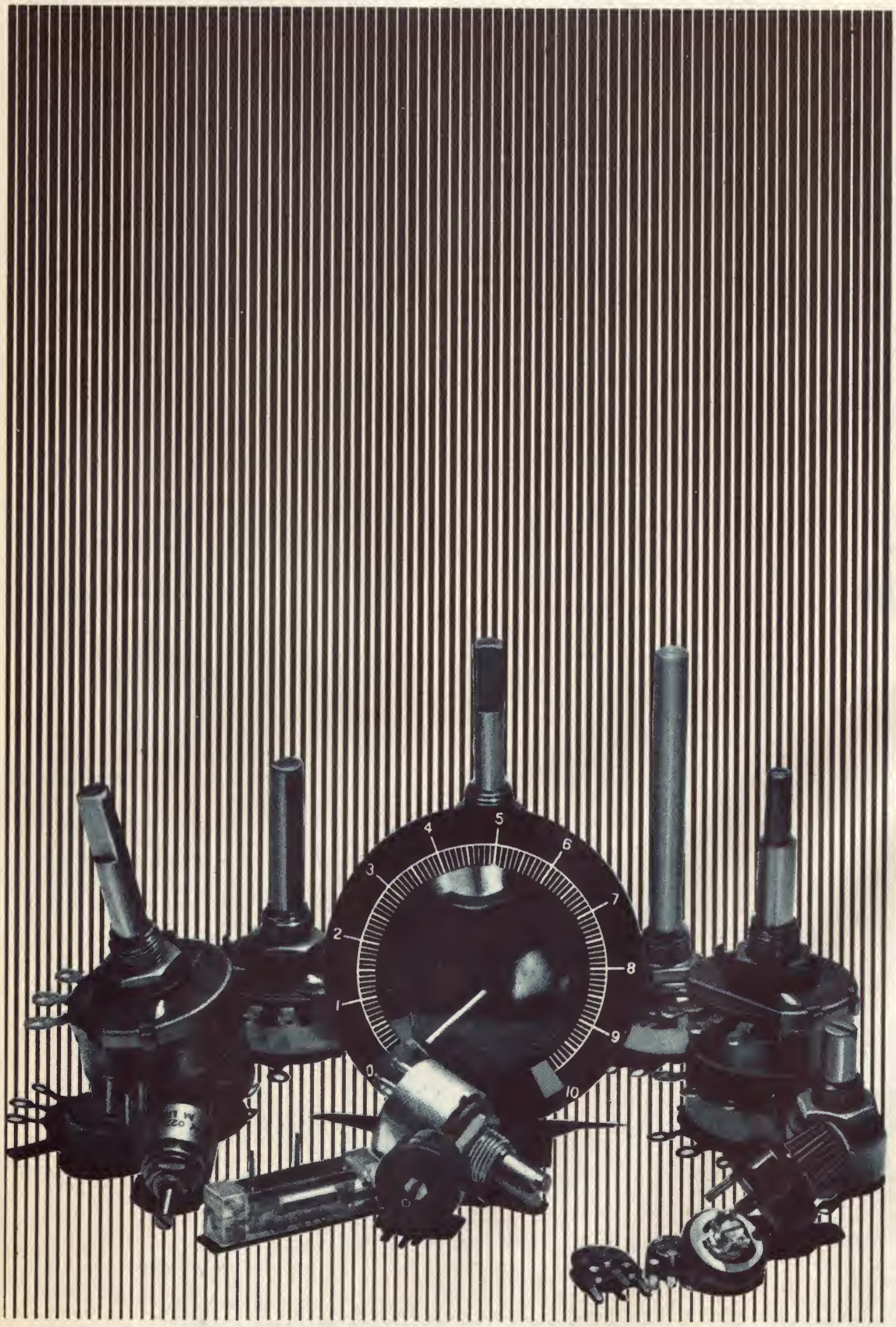
In those new products whose noise reduction circuits will initially employ discrete components but will later use the IC instead, the required change in printed-circuit board design will present no difficulties since levels will be unchanged and the area of board needed will be less.

Dolby Laboratories makes no consumer products but licenses manufacturers who wish to incorporate the Dolby system into their units. The system is currently under license to 30 equipment manufacturers. In addition, more than 20 companies which duplicate cassette tape recordings have purchased the equipment needed to duplicate cassettes that are compatible with the Dolby system. Ray Dolby claims that these recordings, when properly processed, can barely be distinguished from the original master tape made at the recording studio.

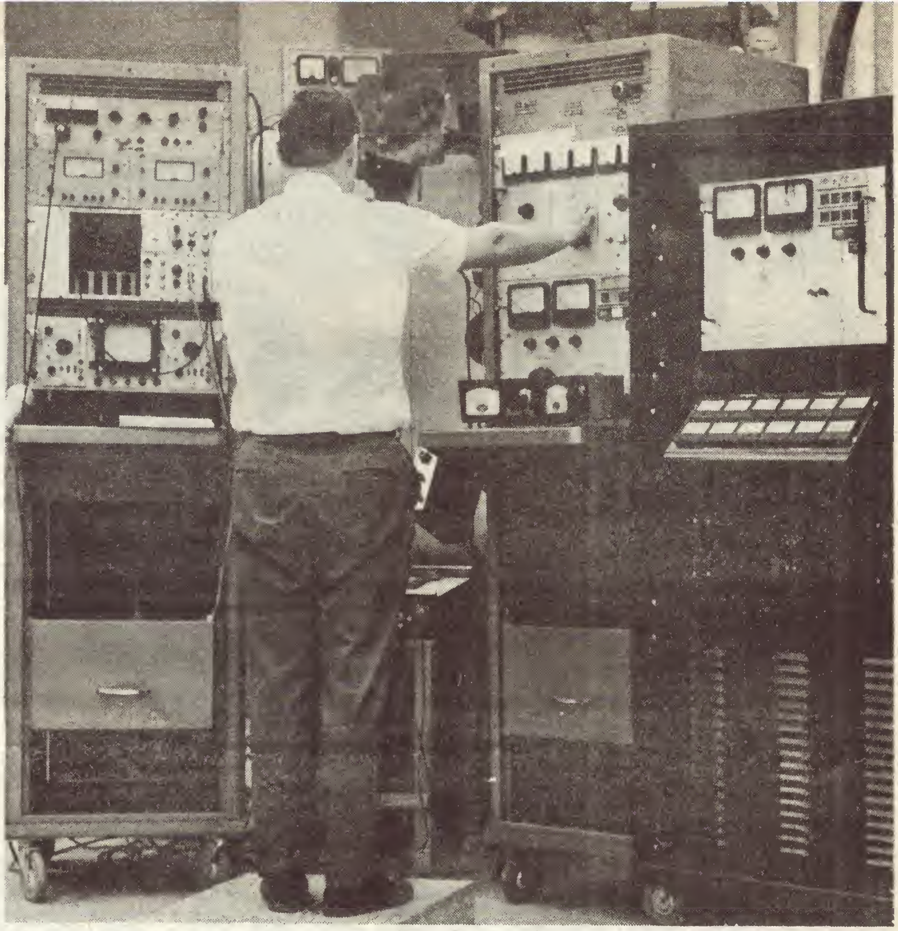
An early version of the Dolby system is now used by Decca / London, Columbia, RCA, EMI, Philips, and more than 400 other firms, including recording companies, motion picture studios, and broadcasting stations.

Block diagram of a proposed Dolby Type B noise reduction processor using the Signetics integrated circuit. IC processor will be interchangeable with discrete component processors now being produced by licensees.





Electron Beam Welding



SMALL PARTICLES MEAN BIG BUSINESS *in Canada, where a team of engineers at Carleton University in Ottawa is developing applications for electron beam technology. G. A. Burbidge, above, operates electron beam welding apparatus in a university laboratory.*

"Take a small rod of tungsten and place it in a vacuum. Form the emitted electrons into a beam with electric fields. Then pass the beam through a hole in a positively charged plate. With magnetic or electric fields, focus the beam and position it on a target."

This recipe was used a century ago to produce a beam of electrons in the historic cathode-ray experiment which serves as the starting-point of knowledge of the electron.

The Crookes' tube experiment for cathode-rays has gone a long way since 1879. Heating the cathode and adjusting the accelerating voltage on the tungsten cathode and the beam current permits this basic apparatus to be used as an electron microscope able to magnify objects over 50,000 times.

It also can be used as a television picture tube or oscilloscope (the target then being a fluorescent screen), as an analytical apparatus using electron diffraction, as an X-ray microprobe or as an apparatus for machining, melting and refining metals.

Aided by operating grants from the National Research Council of Canada, a team of engineers from Carleton University in Ottawa is putting the Crookes' tube principle to yet another use — electron beam welding. Dr J. A. Goldak, Dr M. J. Bibby and G. A. Burbidge form the nucleus of the only laboratory in Canada working on applications of electron beam technology. With a pair of electron beam welding (EBW) facilities which they designed and built they are exploiting EBW in a variety of ways, thereby stirring up interest among several Canadian and foreign firms.

"The basic design was developed by Crookes in 1879," Dr Goldak says. "Patents on these systems were taken out as long ago as 1905 and Von Ardenne in the 1930s gave a good conceptual description of the process. However, the commercial development of electron beam welding did not take place until the 1960s. We had a valuable answer just looking for the right question."

In just six years, this team has amassed an impressive list of accomplishments in electron beam technology. The range of their successful applications could well serve as a broad base for establishing an EBW expertise for industry. A few examples will serve to indicate the potential of electron beam technology.

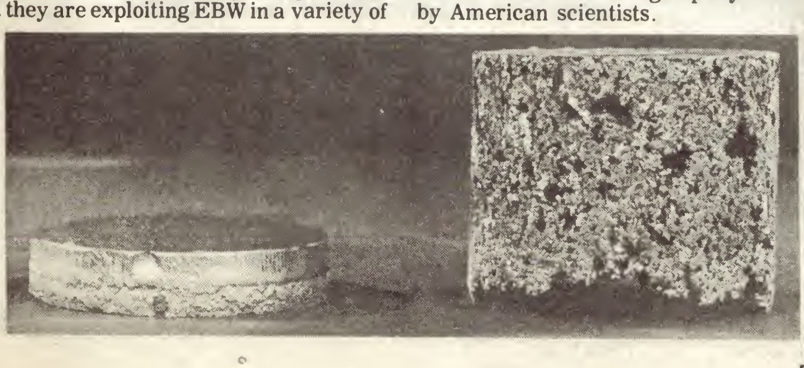
The research group at Carleton was the first in the world to study rock drilling with electron beams. Dr Goldak's mining experience provided the thrust to enter this field which is now being rapidly developed by American scientists.

"The electron beam cuts rock like a hot knife cuts through butter," Dr Goldak says. "A hole one inch deep can be cut in rock in a few seconds and this is done almost noiselessly. Electron beam rock drilling could eliminate almost all blasting in urban areas — only the crackle of the electron beam would be heard. It has enormous potential for drilling, mining, quarrying and digging tunnels."

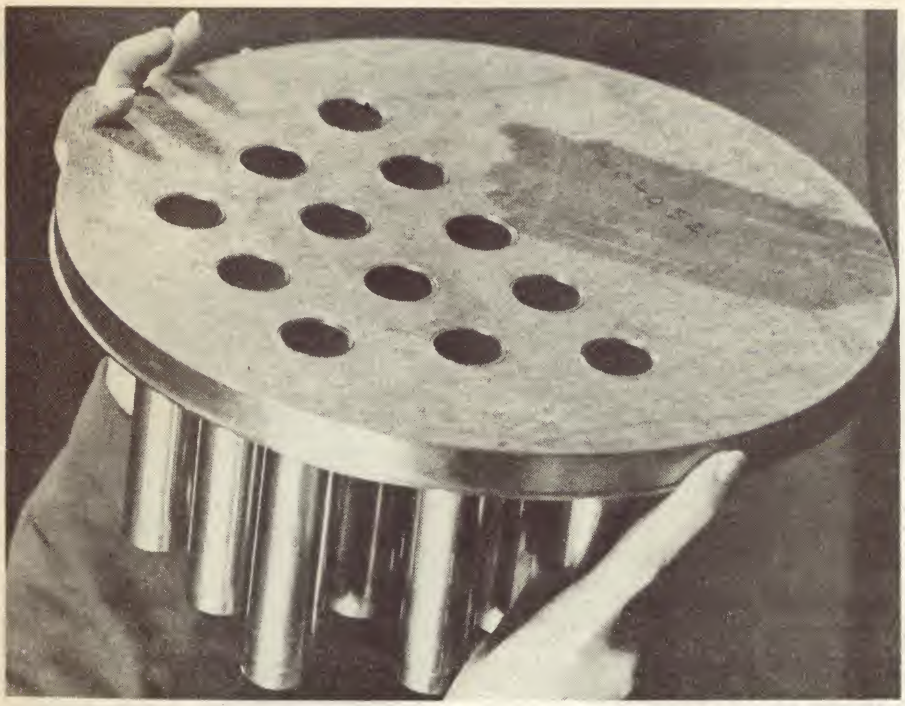
A study of the electron beam welding of rails was carried out by the Carleton University team in collaboration with Canadian National Railways. EBW would cost much less than flashbutt welding and one-thirtieth of the thermite method. The Carleton engineers developed the EBW techniques to weld rails with whatever mechanical properties (strength, toughness, resistance to fatigue) the railway specified.

Dr Goldak and his associates have manufactured the first electron beam welded microwave filter. The performance of the filter depends on the mechanical accuracy of construction and particularly on the weld and consequent electrical conductivity in joints between thin foils of metal and the walls of the filter. There are 36 of these welds, along with eight other welds in each filter.

This microwave filter was produced at



Steel and zirconium ingots can be remelted with an electron beam to remove defects, thus eliminating wasteful machining processes. Ingot at far left has been conditioned by electron beam from an ingot the size of the one at the right.



Bell-Northern Research, Ottawa, and welded at Carleton University. It was significantly more efficient than any previous microwave filter. A filter of this type not only reduces the transmitter power needed for satellites but also reduced a proposed satellite package from 23 to eight pounds.

Steel and zirconium products are often manufactured from large bars, called ingots, if the bars are cast, and billets, if they are formed. Defects in these bars are usually machined off with lathes, cutting torches or grinding machines. This involves a loss of material which for zirconium is estimated at $300,000 per year in Canada alone.

In the low-carbon steel industry, the cost of removing defects, that is the cost of labor and supplies but not the yield loss, approximates 50 million dollars per year in Canada and a thousand million dollars per year on a world scale.

When the Carleton group used electron beams to remelt the defective volume, pores and cracks remelted and froze without defects. The result was a better surface than obtained using conventional methods — with no yield loss. An improved over-all product was obtained at only a fraction of the cost.

During EBW studies, methods were developed and perfected for welding "gassy" low-carbon steels with high initial oxygen content. Unless precautions are taken, the gas causes bubbles or pores which weaken the weld. Deoxidizers used with these gassy steels and welds using electron beams proved highly satisfactory.

Heat exchangers contain hundreds of tubes (usually stainless steel) passing through plates up to 15 inches thick. A good, pressure-tight weld between tube and sheet is an absolute must and literally millions of such welds are needed in a nuclear reactor.

The Carleton University research team designed an electron beam welder for tube-to-tube sheet welding that would reduce the time per weld from 15 minutes to less than

Heat exchanger constructed with electron beam welding. EBW gives a 10:1 reduction in welding time for this type of weld and provides a superior weld.

15 seconds. In addition, the electron beam presents advantages for the quality of the weld. It is narrow and deep-penetrating, and "slides" down between tube and sheet for a deep weld.

Another important advantage of the electron beam welder for this and numerous other projects is that it is an electronic device which means the welding process can be automated. In fact EBW really shines when there are many repetitions of the same process to be carried out. Once the magnetic fields for focussing and deflecting the beam are modified and made to alternate as desired (and this can be done by machine), the rest can be automated and largely controlled by computer.

"In order to continue our work in developing and perfecting applications of EBW, we intend to improve the design of the equipment," says Dr Goldak. "We could build better electron beam guns and systems right here in our laboratory. At present, the tungsten cathodes must be replaced from time to time. The design and material used in this cathode could be improved for longer life. The optical system for focussing high-power beams could profit from more research as could the procedure for automatic welding with a scanning beam.

"The electron beam now serves to cure paints, engrave photographic plates, make artificial leather, drill, cut, machine, refine and melt. Electron beam technology has become commercially important only during the last 15 years and its future looks extremely promising. As for electron beam welding, it will keep pace with the needs of developing technology. It will provide higher quality welding, consistently, reproducibly, with the added advantage of low labour costs."

Automatic fingerprint

Computerised fingerprint recognition is fast evolving from theory to a practical reality. The following article is a condensation of a paper read by the author, L. Brian Hunt, BSc, at Datafair 71, University of Nottingham, England.

Fingerprint recognition is concerned with two main types of print: registration prints and scene-of-crime marks. The latter are often smudged and incomplete, and are therefore a job for a trained fingerprint expert.

Registration prints, however, having been taken under ideal conditions, lend themselves to automated filing and retrieval. Manual coding methods cannot handle the sheer volume of registration prints being taken annually, so electronic scanning, recognition and retrieval methods are under development.

The method described here is an experimental one developed by the author and others at Software Sciences Ltd, 17 Curzon St, London W1Y.

Fingerprints can be considered as made up from a relatively small number of easily defined pattern elements — loops, whorls, arches, etc — and these main classes can be subdivided according to the general internal structure of the ridge pattern. A further subdivision in a fingerprint consists of the relative positions of ridge endings and ridge forks with respect to each other.

Ridge endings and forks are often referred to as "minutiae." Is is generally accepted in British courts of law that if 16 such minutiae can be matched between two given fingerprints, then the two prints come from the same finger. However, a fingerprint officer can establish identity with six matching minutiae and in exceptional cases even with fewer.

The main purpose of recognition automation is to reduce time spent by experts in narrowing down possible matches to a few likely possibilities. The final match is always done by a fingerprint officer.

The desired objectives of any automated fingerprint recognition scheme are threefold:

Standardisation — the selection of a set of clearly defined and quantifiable criteria by which prints can be classified.

Classification — the filing of a new, known fingerprint so that it may be retrieved for visual scanning, and in order that its inherent characteristics can be used to recognise unknown prints.

Recognition — a retrieval process for the classification of an unknown print or fragment of a print.

Readers familiar with pattern recognition methods will appreciate that a pattern-by-pattern comparison of an unknown print with every one in a file is not an economic proposition and hence some form of class system for recognition must be devised.

Two different types of scanner have been used. The first was a flying-spot device built in the Computer Science Division of the National Physical Laboratory (NPL) for inhouse experiments on character recognition. The second device belongs to the Medical Research Council (MRC).

In the NPL device the image of a spot of light on the surface of a cathode-ray tube is projected on to the fingerprint as the spot is scanned across the crt and the reflected light is picked up by a photomultiplier. The resulting electrical signal is continuously sampled and converted into a six-bit binary code. The value of the code at each sample point indicates the intensity of the reflected light at that instant.

Using this technique any rectangular array of points can be scanned, up to a maximum of 256 x 256. The physical range of the scan depends on the reduction obtained by the optics used. For example, the maximum reduction that could be obtained for fingerprints was considered to be approximately 400 points to the inch (160 to the centimetre). This information was put on to paper tape as the scanning proceeded, the production time of a typical 256 x 256 array being approximately 15 minutes.

Because the NPL apparatus had to be operationally fully extended to obtain the required resolution (causing other problems), it was decided to investigate the use of the MRC scanner. This works on an entirely different principle and has its own computer control which is itself linked into a PDP9 computer. A fully interactive graphics display, with a light-pen, allows examination and adjustments to be made on-line to the image as well as allowing automatic thresholding and gain-control of the detected signal. An image of the fingerprint is projected on to a very high-resolution photo-sensitive eye somewhat similar to a television camera.

This system allows the intensity to be detected using any number of grey levels up to a maximum of 256. The resolution is sufficient for routine examination of human chromosomes and hence was considered to be suitable for fingerprints. Each scanned and encoded image was recorded on a disc store in the PDP9 in a matter of seconds, but again a considerably longer time was required to convert the image on to paper tape for more permanent storage. This scanner was also used to produce a matrix of 256 x 256 points and typically this used approximately 546 feet (166m) of paper tape for each complete scan.

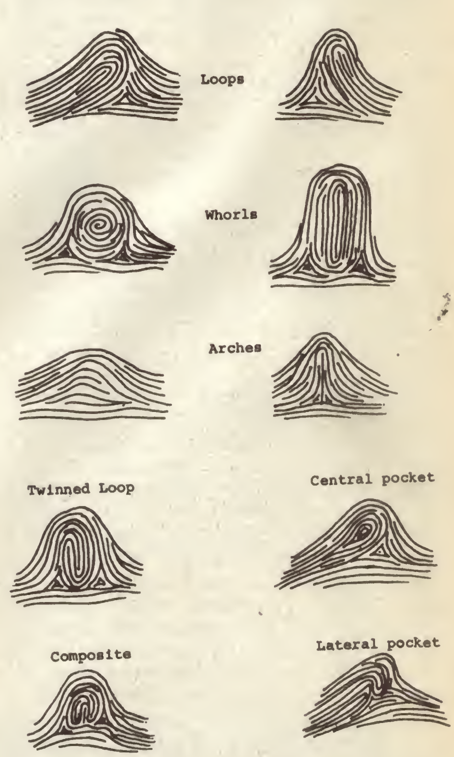
The paper tapes produced by the scanner were read into the ICL 1905 at the City University by a specially tailored subroutine and thus the data were stored on a magnetic-tape file preparatory to the next phase. A print-out of a typical scan displayed on an eight-level grey scale is illustrated.

Other workers in the field have been content to encode the fingerprints by means of rules for orientation of the print and by marking pointers on the print indicating the positions of the various minutiae. Such procedures, in addition to requiring skilled human participation to reduce the data, assume that recognition of a print can be achieved without using the tremendous volume of data associated with the relative curvature of the ridges and types of ridge connections between given minutiae. Part of the philosophy of the work described here has been to try to avoid human intervention of any kind, although, as will be seen later, certain situations make some such participation inevitable.

Every fingerprint record contains "noise" and can be regarded as having been subjected to mutilation in its passage from the original finger to the magnetic-tape file. It is possible to build into the recognition algorithms procedures which are "aware" of this fact. However, this makes them extremely complicated and increases development and debugging times of the computer programs.

A preferable and more modular concept consists of processing fingerprint images with a set of cleaning-up algorithms which are designed to remove, or reduce as far as possible, the effects of the mutilation. The five main regions of effort that can be distinguished are filtering, thresholding, thinning, editing, and distortion-tolerant measurement.

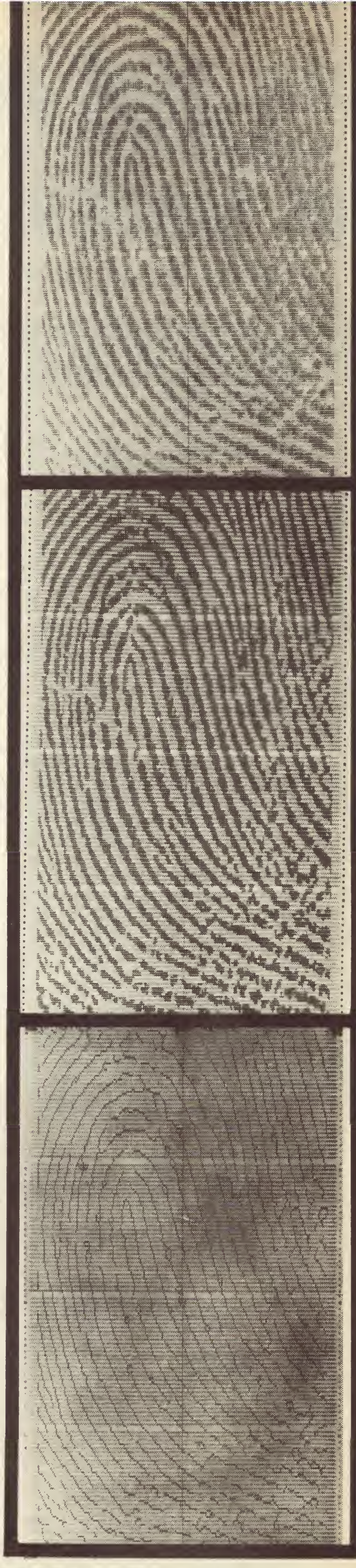
The last of these five regions presents the most difficult problem; so far the only satisfactory solution has been to ensure that the recognition algorithm is insensitive to as large a level of variation in detail as possible, consistent with the ability to distinguish between any two different



Main fingerprint classes used for classification.

recognition——

At right is a typical eight-level grey-scale scanned and coded fingerprint before "cleaning up." Immediately below (centre) is the same fingerprint after being thresholded. After high and low pass filtering, the print is thinned to a pattern of lines only one dot wide as in bottom example.

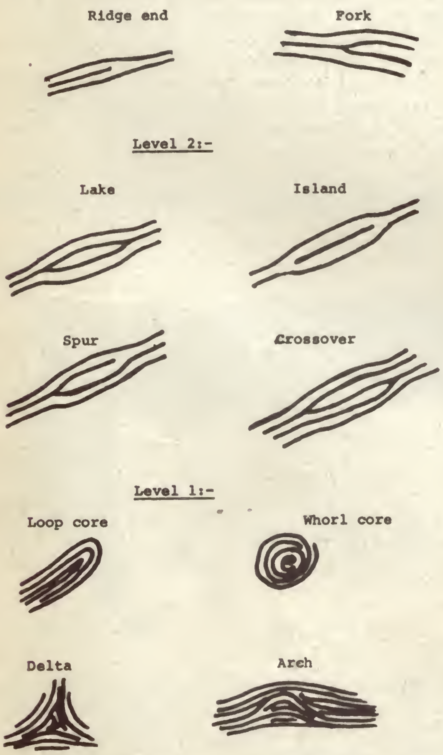


fingerprints. The following details provide a brief introduction to the various processes:

The filtering process is intended primarily to remove "salt and pepper" type noise and shading effects, while the thresholding process converts the image to a black-on-white representation; the thinning process reduces the resulting variable-width black strips to unit (one dot wide) thickness. The segmentation process produces straight-line approximations to all the lines, and the editing process merely examines the thinned image and makes simple decisions about whether disconnections or connections should be made.

The feature abstraction or description process is concerned with the basic grammar and syntax of fingerprints and with the process of detection of the relative positions and orientations of the minutiae and of groups of such minutiae for a given fingerprint.

It is based on the detection of a set of basic symbols generally referred to as an Iconic Alphabet. The primitive relationships between these symbols, which determine whether a given configuration of them is an item of interest (in the context of the particular problem), are referred to as the Pattern Grammar. The breaking down of complex patterns into these primitive symbols and according to the accepted grammatical rules, in order to arrive at a descriptive statement (feature) of the pattern, is referred to as two-dimensional syntax analysis.



Examples of the feature levels used for recognition.

For the purposes of fingerprint recognition the Iconic Alphabet has been assumed to consist simply of the various types of line endings. The grammar is the set of empirical rules built into the subroutines which determine whether a particular grouping of line endings or line endings and adjacent lines represents a valid fingerprint statement. Some of the rules may be recursive in that they can apply to any degree of complexity of statements. However, for the purposes of this research, and to conform with the philosophy of maintaining simplicity wherever possible, only elementary geometrical rules are used and these rules apply to only three levels of features: ridge ends, forks; islands, lakes, crossovers, spurs; cores, deltas and arches (see illustration).

Each feature is assigned a unique direction (where possible) and a unique position in order that it may be related to neighbouring features. The position and direction of any feature with respect to some other feature (which is temporarily used as a reference) define three geometrical properties which, combined with the feature type give a total of four properties that can be assigned to a relationship between any two features. The three geometrical properties are: separation, angle (between the defining directions of the two features), and orientation of the line joining the two features with respect to the direction of the reference feature.

A practical difficulty associated with setting up relationships between the different types of feature listed is that mutilation and "noise" often convert one type of feature irretrievably into another. For example, ridge ends and forks are interchangeable in this way as are islands, lakes, crossovers and spurs. This difficulty can only be alleviated by assigning weights to the features during the recognition process and basing the final decision on whichever interrogation path has produced the greatest (least) score.

A series of yes/no tests regarding the presence or absence of each feature is generated at each feature level, and as soon as the features at one level are exhausted questions at the next lower level are initiated. This process is repeated until all the features in the first-chosen print are exhausted.

Every attempt has been made to excise the human element from the system and certainly this applies wherever routine tasks are involved. However, at the current level of computer technology and with the need for higher-level decision-making functions, human participation in scene-of-crime mark recognition processes is felt to be essential.

Low cost utility amplifier for electric guitars

A compact unit with 21 watts continuous output capability, very suitable for either practice work or for use in small halls. The circuitry is fully solid state, using a modern power IC, and printed boards are used to simplify assembly.

by LEO SIMPSON

Guitar amplifiers range in power from very compact "practice" units incorporating a small loudspeaker with only a few watts drive, up to very large models with price tags in the four-figure range and ratings of several hundred watts. In between these extremes there is a vast area of confusion where the would-be guitarist often tends to muddle along with an amplifier which does not really suit his purpose.

Most guitarists appear to need only a compact amplifier for playing and practising at home and ideally, it will have an extra reserve of power to be used at parties and dances in small halls. To this end, they do not need an amplifier with a hundred watts output, although it is surprising just how many think they do. An amplifier with 10 to 20 watts will be more than adequate for many situations.

Our experience with the Playmaster 102 and 103 guitar amplifiers published during 1963 supports these conclusions. The Playmaster 102 was a valve amplifier with an output of 12 watts yet it was very popular. The Playmaster 103 had an extra reverb channel of similar power output. We believe the guitarist of today has not changed greatly from his counterpart of ten years ago in the uses he can find for a modest system.

We had these thoughts in mind when we developed the 20W PA amplifier presented in the June 1972 issue. The unit presented here uses the same power amplifier and utilises the same chassis.

Continuous power output is 21 watts into 8 ohms and 13 watts into a 16 ohm load. Harmonic distortion at 1KHz for 21 watts is less than 0.3%, while at lower powers it is typically less than 0.1%. For those guitarists who like to parry with figures, its "music power" is of the order of 30 watts into 8 ohms, depending on which method is used to measure it. Similarly, the "peak music power" can be quoted, if you so wish, as 60 watts. These figures are quoted, not because they have any special meaning but so that guitarists can relate them to other amplifiers.

Since the amplifier is intended for use at practice sessions, a headphone socket has been fitted on the rear panel. This is suitable for conventional stereo headphones of high or low impedance and enables the guitarist to play without disturbing anyone.

Lest we are swamped with correspondence asking how to fit headphone sockets to existing units, we warn readers that many guitar amplifiers are just not quiet enough to enable headphones to be successfully used. The unit presented there has no problems in this respect — it is very quiet, at all gain settings.

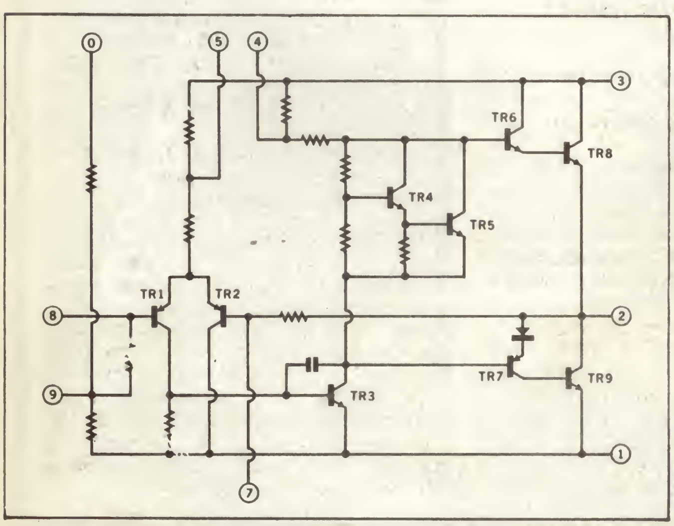
As with the PA amplifier referred to above, the heart of the unit is the 20 watt thick film hybrid IC, type TA 20B, distributed in Australia by STC. Some readers will perhaps remark that we should have used the higher powered unit, TA 25B. There are two reasons why we did not.

First we believe the slightly increased power capability does not justify the extra cost. It would not be audible, anyway. Second, the power transformer used, a reasonably economical "off the shelf" unit, will not deliver the extra power. If we had specified a transformer with ratings to suit the TA 25B, its cost could be as much as 50% more. As it is, the transformer specified is ideally suited to the TA 20B.

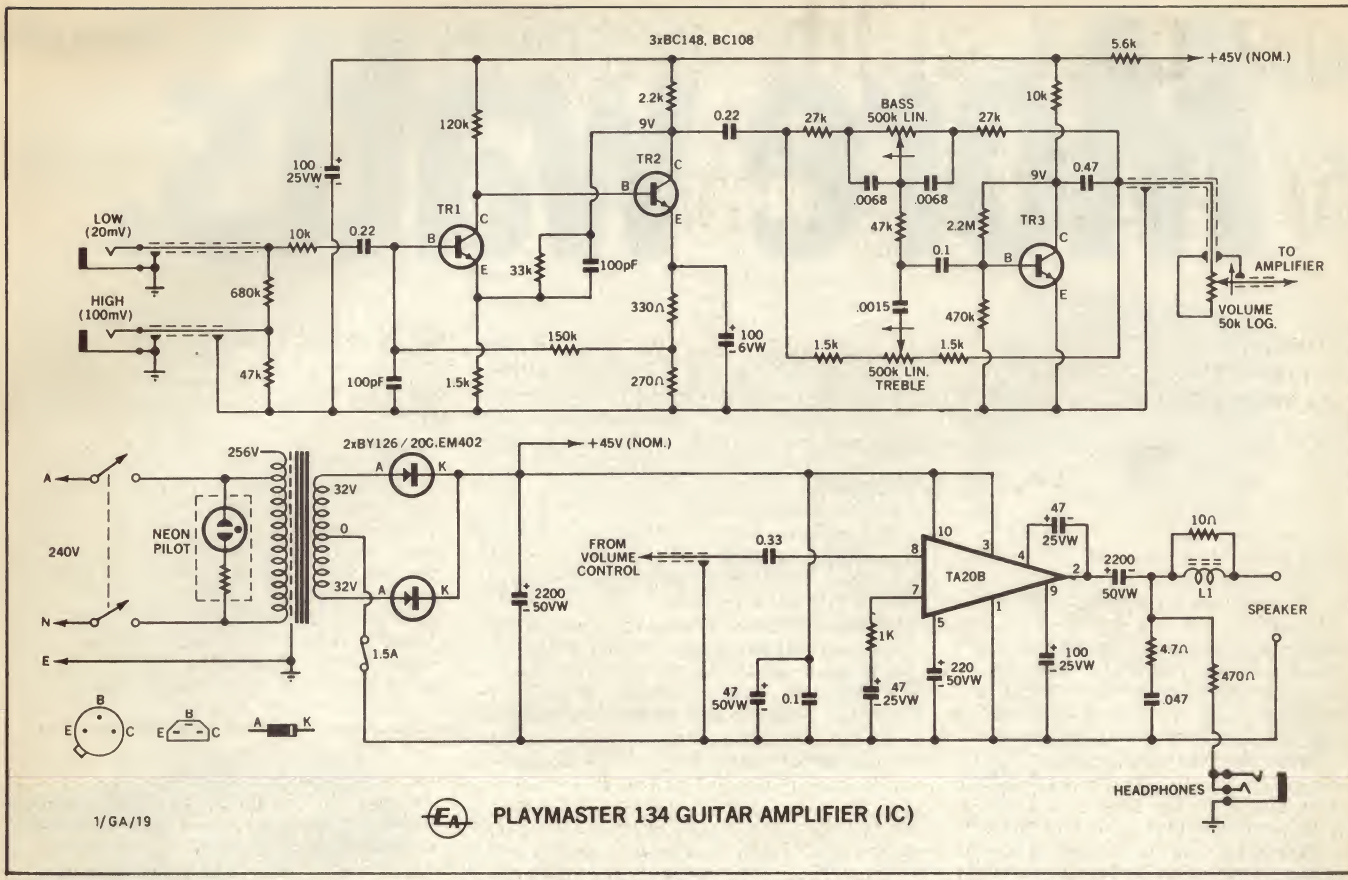
Two jack sockets are provided to accept inputs from guitars. Sensitivities are 20mV and 110mV respectively for full power. The less sensitive input can be used for bass guitar or guitars which have more than usual signal output. Use of the less sensitive input prevents overloading of the preamplifier stage. Input impedance is ap-

SPECIFICATIONS

Power: 21 watts continuous into an 8-ohm load; 13 watts continuous into a 16 ohm load.
Distortion: Less than 0.3% at 21 watts into 8 ohms at 1kHz; at lower power, within range 100Hz to 10kHz typically less than 0.2%.
Frequency response at 1 watt: +2dB from 20Hz to 20kHz.
Tone control: ±18dB at 10kHz; ±17dB at 50Hz.
Sensitivity: 20mV (LOW) or 110mV (HIGH) for 21 watts into 8 ohm loads.
Signal-to-noise ratio: Better than 56dB for both inputs.



High-powered guitar amplifiers with a loudspeaker system to match are a status symbol but they are also beyond the means of many would-be musicians. Our new economy amplifier is built around a single integrated circuit, the circuit of which is shown at left. How it operates is explained in the accompanying article.



Circuit details of the new design. Preamplifier is at the top, IC power amplifier at the bottom.

proximately 100k for the LOW input and 47k for the HIGH input (less sensitive).

Tone controls for a guitar amplifier usually provide more bass and treble boost and cut than is normal with "high fidelity" amplifiers. This is to allow the guitarist more flexibility in setting the tone of his instrument. Accordingly, the tone controls on this unit provide ± 17dB at 50Hz and ± 18dB at 10kHz.

Frequency response for both inputs is ± 2dB from 20Hz to 20kHz, with the tone controls set for a flat response. Signal to noise ratio for both inputs is better than 56dB with respect to 20 watts. This measurement is taken, with the inputs unloaded, ie, open-circuit, and the figure is unweighted which means that it refers to wideband noise.

A problem which often plagues the users of guitar amplifiers is RF breakthrough from mobile radios in taxis, radar, broadcast and shortwave stations. As with the PA amplifier featured in our June issue, we have taken extensive precautions to avoid the problem. The amplifier is also relatively insensitive to mains-borne interference such as commutator hash from food mixers and other universal motors, clicks and pops from switched inductive loads such as refrigerators and fluorescent lamps.

Although perhaps desirable, electronic short-circuit protection has not been provided. The amplifier will withstand short-circuits of a brief duration without damage — the fuse is blown. However prolonged overloads, such as using the amplifier with a loudspeaker of too low an impedance will cause permanent damage. Do not use loudspeakers of less than 8 ohms

YOU'LL NEED THESE COMPONENTS:

1 chassis, 10⅛ x 8⅜ x 3¼ inches, with cover
1 reinforcing angle piece (see text)
1 neon pilot shield (see diagram)
1 power transformer, 64V centre tapped, at 2A AC.
1 printed board, 72a6
1 printed board, 72g7
2 microphone jack sockets, 10mm non-shorting type.
1 stereo headphone socket.
1 2-pin loadspeaker socket
1 fuseholder and 1.5 amp fuse
3 knobs
1 front panel
1 neon pilot lamp assembly (with limiting resistor)
1 miniature 240VAC DPST switch
1 8-lug tagstrip
1 mains cord clamp
4 rubber feet

SEMICONDUCTORS

2 EM402 or BY126/200 silicon diodes 3 BC108, BC148, or 2N3565 silicon NPN transistors
1 TA20B power amplifier IC (STC)

CAPACITORS

2 x 2200uF/50VW electrolytic
1 x 220uF/50VW electrolytic
1 x 100uF/25VW electrolytic
1 x 47uF/50VW electrolytic
2 x 47uF/25VW electrolytic
1 x 100uF/6VW electrolytic
1 x 0.47/100VW metallised polyester
1 x 0.33uF/100VW metallised polyester
2 x 0.22uF/100VW metallised polyester
1 x 0.1uF/100VW polyestery
1 x 0.047uF/polyester
2 x .0068uF/100VW polyester or polystyrene
1 x .0015uF/100VW polyester or polystyrene
2 x 100pF polystyrene or ceramic

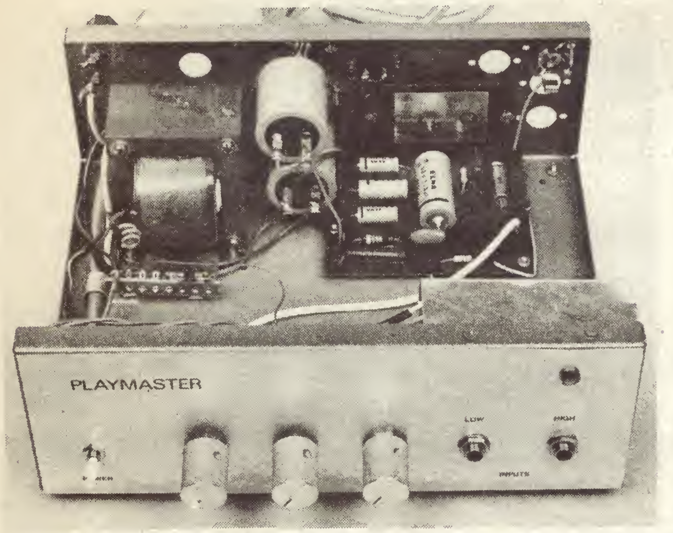
RESISTORS

(all 10% tolerance, ½ watt)
1 x 2.2M, 1 x 680k, 1 x 470k, 1 x 150k, 1 x 120k, 1 x 47k, 1 x 33k, 2 x 27k, 2 x 10k, 1 x 5.6k
1 x 2.2k, 3 x 1.5k, 1 x 1k, 1 x 470 ohms, 1 x 330 ohms
1 x 270 ohms, 1 x 10 ohms, 1 x 4.7 ohms.
2 x 500k (lin) potentiometers
1 x 50k (log) potentiometer

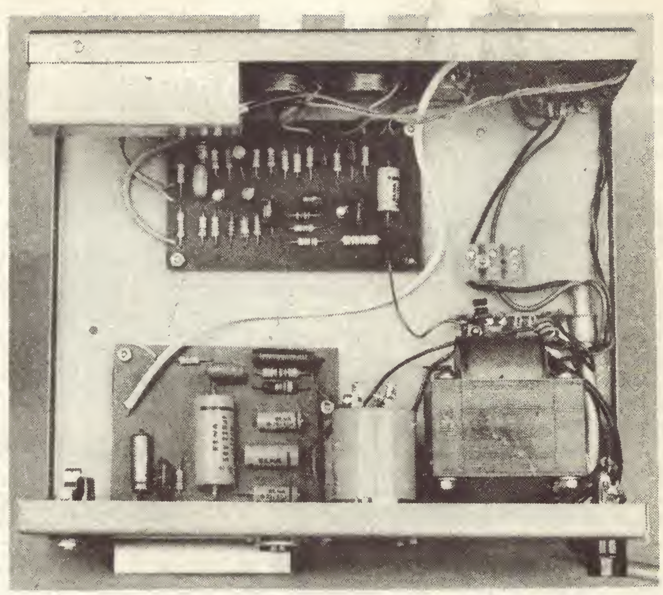
MISCELLANEOUS

Mains cord and plug, shielded cable, hook-up wire, ferrite rod, screws, nuts, lockwashers, solder.
Note: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with higher ratings may generally be used, providing they are physically compatible. Components with lower ratings may also be used in some cases, providing the ratings are not exceeded.

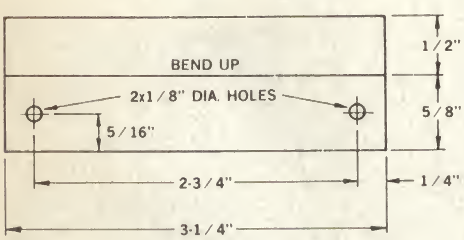
INSIDE THE AMPLIFIER CHASSIS



The picture shows the power supply (left) and the basic power amplifier (right), with the IC bolted against the rear panel. Note the shield around the pilot lamp to minimise hum pickup.



A top view of the amplifier emphasises its extreme simplicity. Note the small aluminium angle bracket bolted outside the chassis and behind the IC, to ensure an intimate thermal contact.



The sketch at left shows suggested dimensions for the angle bracket which backs up the power IC. 16g aluminium would be the obvious choice.

impedance, therefore.

Let us now discuss the internal circuitry of the TA 20B integrated circuit. This is based on the conventional "quasi-complementary" class-B configuration but it has several interesting features.

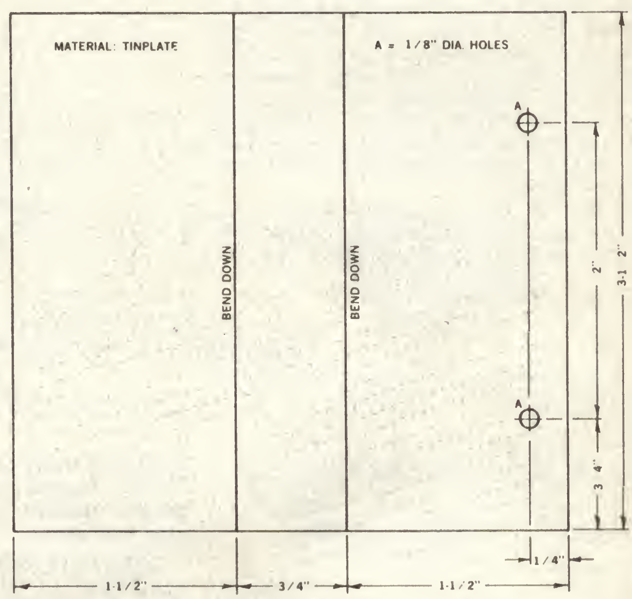
First of these is the differential amplifier stage consisting of Tr1 and Tr2. Besides contributing to high "open-loop" gain (ie, gain without negative feedback applied) it increases the ripple rejection of the amplifier. This is just another way of saying it reduces the hum in the output. A resistor from the output to the base of Tr2 provides 100% DC feedback to ensure stability of the "half-supply" voltage at the output. This ensures symmetrical clipping of the output signal at the onset of overload, regardless of supply variations.

This last feature is very important since it means that the amplifier develops maximum power without distortion. (If the DC voltage at the output of this type of amplifier is not set correctly to suit the supply voltage, the output signal cannot make the maximum symmetrical "swing" and consequently the power available before overload is reduced.)

Tr3 provides further voltage amplification and acts as the class-A driver stage for the output driver transistors Tr6 and Tr7. Phase-splitting for the NPN output transistors takes place in the driver transistors.

A diode in series with the emitter of Tr7 improves the symmetry of the quasi-complementary output stage and greatly reduces the harmonic distortion at low power levels.

Indicated at right are the dimensions for the pilot lamp shield which can be bent up from a scrap of tinplate obtained, if necessary, from a preserved fruit can.



As with all class-B amplifiers intended for high quality sound reproduction, the output stage transistors are slightly forward biased. The small current resulting is called the quiescent or "no-signal" current and it provides a smooth transition between the conduction of one of the output transistors to the "cut-off" of the other. The quiescent current in this amplifier is set by the voltage drop across the Darlington transistor consisting of Tr4 and Tr5.

Normally, the quiescent current should be about 30mA, and certainly no more than 50mA.

Boot-strapping (ie, positive feedback) is applied from the output to the input of Tr6 via a 47uF / 25VW capacitor. This ensures that the full voltage swing is available at the output and enables more linear operation of the class-A driver stage, Tr3.

Voltage gain of the amplifier is set by the ratio of the internal resistor from pin 2 to the base of Tr2 to the 1k external resistor at pin 7. The low frequency cut-off characteristic is determined by the time constant of the 1k resistor and its associated 47uF capacitor.

As it stands, typical voltage gain of the amplifier is 30 times, for all load impedances. Input impedance is approximately 20k.

All the amplifier external components, apart from the 2200uF output coupling capacitor are mounted on a printed board measuring 3¼ x 4 inches. Besides the components already mentioned there are two supply decoupling capacitors, 47uF and 220uF and an RF supply bypass capacitor, 0.1uF. The latter capacitor is mounted on the underside of the board, directly between pins 1 and 3 of the TA 20B.

The rest of the components on the board are the 0.33uF input coupling capacitor, the 470 ohm resistor feeding the headphone socket, a Zobel stabilising network consisting of a 4.7 ohm resistor and .047uF

capacitor in series, and also an RF choke L1 in parallel with a 10 ohm resistor.

These last four components ensure that the amplifier is stable with reactive loads, both inductive and capacitive. Thus the amplifier is completely stable with any capacitance up to 1uF shunting the load.

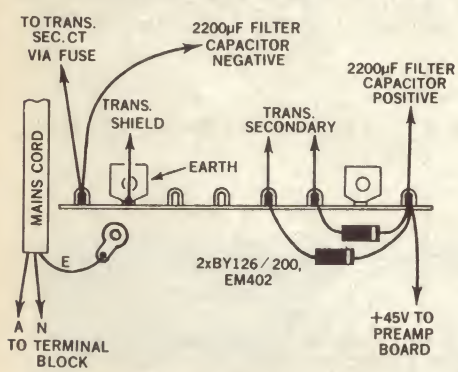
Driving the power amplifier is a three-transistor circuit which provides the necessary signal amplification and the variable tone control facility.

Two NPN transistors make up the direct coupled preamplifier circuit which has a voltage gain of approximately 22 times. This is set by the ratio of the 33k resistor to the 1.5k resistor. Bias for the input transistor is derived from the junction of the 330 and 270 ohm resistors. Notice that there are two DC feedback networks in the circuit, one the bias network and the other the 33k resistor to the emitter of the input transistor. These networks interact so that if one is changed so must the other.

A 100pF capacitor shunting the 33k resistor increases the negative feedback at high frequencies and thus rolls off the response above the audible range to assure low RF sensitivity.

In addition to rolling off the response at high frequencies, there is an RF attenuation network in the input circuit consisting of a series 10k capacitor and shunt 100pF capacitor. This prevents strong RF signals entering the base of the input transistor which can "detect" them due to the basic non-linearities of its junctions. If the signal is detected it becomes audible. (This is why an amplifier can sometimes reproduce taxi conversations.)

Following the preamplifier stage is the active tone control stage using a single NPN transistor. This stage has a gain of 1 at mid-



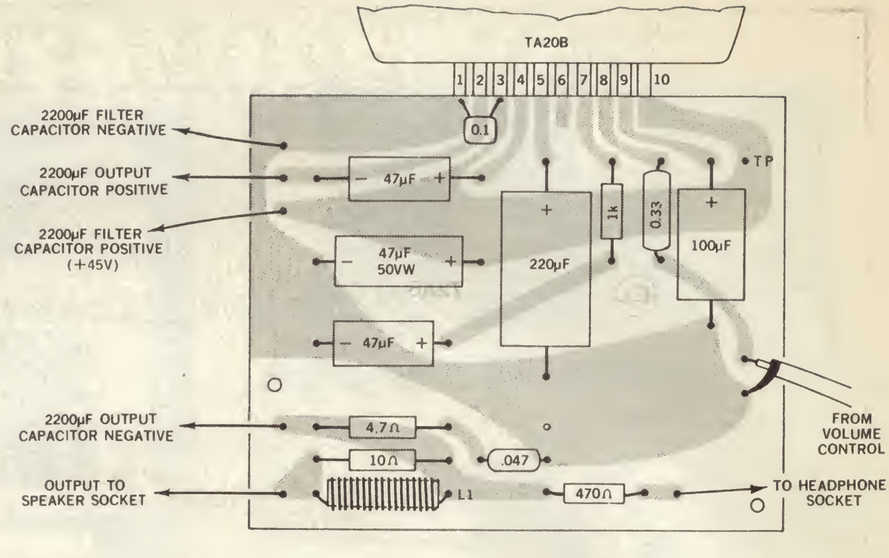
The power supply wiring and components can be terminated on a single tagstrip as shown above.

frequencies, with tone controls set for flat response.

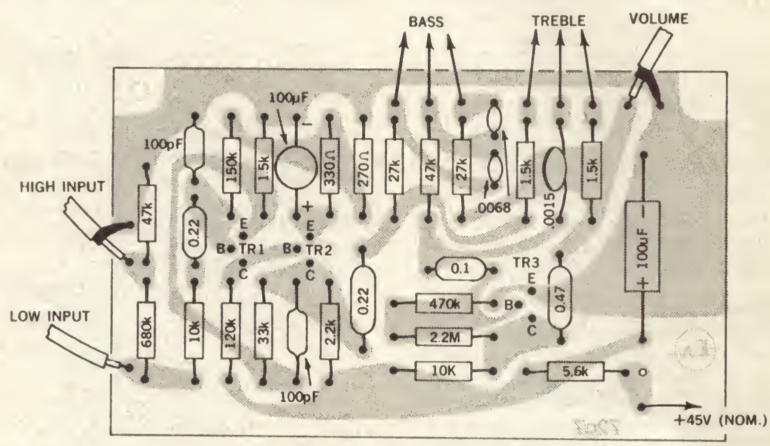
All the preamplifier and tone control circuitry, with the exception of the potentiometers, is mounted on a printed board measuring 4½ x 2¾ inches.

The power supply for the amplifier is simplicity itself. The power transformer has two 32 volt windings which are connected in series to give 64 volts centre-tapped. The power transformer is the same as for the 10-plus-10 stereo amplifier published in April 1969; suitable type numbers are the Ferguson PF 2876 or the A & R PT 6413. A full-wave rectifier consisting of two 200 PIV / 1 amp silicon diodes supplies the filter / reservoir capacitor.

A 1.5amp fuse connected in series with the



Most of the wiring in the amplifier is concentrated on two boards, the preamplifier below and the power amplifier above. The pins of the TA 20B IC solder directly to the pattern as indicated.



centre-tap connection provides protection for the amplifier and power supply components against short circuit loads and over loading.

CONSTRUCTION: The amplifier is assembled in a chassis with overall dimensions of 10⅛ x 3¼ x 8⅜ inches (257 x 83 x 213mm). The chassis is, in fact, a slightly modified version of that used for the Playmaster 129 integrated circuit amplifier published in October 1970. It was supplied by courtesy of Heating Systems Pty Ltd, 19-21 The Boulevarde, Caringbah, 2229. We assume that chassis will be available for the amplifier shortly after this issue goes on sale.

First component to be mounted is the power transformer. After this, the 2200uF can-type capacitors, fuseholder and sockets on the rear panel can be installed. Cut the potentiometer shafts to length (about ½ inch) and mount them, together with the input sockets and power switch.

Note that the front panel components will have to be removed when the escutcheon panel is mounted. This should be left until the amplifier is complete and tested to avoid marks and scratches. For the same reason, the neon pilot lamp is left until last.

The power amplifier board can now be assembled. All the passive components, with the exception of the 0.1uF capacitor should be installed first. The RF choke L1 consists of 20 turns of 22 SWG enamelled copper wire on a 1in long section of ¼in diameter ferrite rod. Remember that if a ferrite rod has to be cut to length, it may be done by filing a nick around the circumference at the required point and snapping as if it were glass.

The integrated circuit pins are soldered direct to the edge of the printed board. The ten pins are bent up at right-angles at the point where they taper suddenly. The board assembly can then be installed. It is supported by two screws and nuts so that it has ¼in clearance from the chassis. The integrated circuit is secured to the rear of the chassis by two screws.

If the screws are over-tightened the chassis rear will become warped, and if this occurrs it will not make good thermal contact with the metal backing of the integrated circuit. To avoid this, an L-shaped reinforcing piece should be secured to the rear of the chassis with the same screws that hold the IC in place. Silicone jelly should be lightly smeared over the back of the IC to improve thermal contact.

Continued on page 125

THAT ANNOYING HUM...

and what you can do about it

There is more to wiring a record playing deck than simply attaching shielded output leads from the pickup and a 3-core power flex for the motor. Sometimes these leads can interact to produce an unexpected source of hum in a hi-fi system.

by NEVILLE WILLIAMS

This article was triggered off by a situation which one of our staff members encountered recently, in a private capacity. It reminded us of letters which come to hand from time to time indicating that the problem, while not common, is certainly not unique.

The case in point involved a stereo playing deck, an amplifier and a pair of loudspeakers which an enthusiast had purchased separately and connected together. The system worked well except for one particular fault: When set for normal listening level in the room, an annoying mains hum was evident between tracks on the record and during the quieter musical passages.

If any attempt was made to use bass boost, the hum level became quite objectionable. The problem was to isolate the cause and effect a cure.

Seemingly the amplifier was not at fault, since unplugging the pickup leads while leaving the volume control untouched removed all signs of the hum.

There was an alternative possibility of the hum being induced from the motor windings into the cartridge but another routine observation largely eliminated this possibility. With everything operating normally, the pickup was raised just above the surface of the disc and swung from its rest position towards the label. With induced hum, the level would almost certainly have varied with position; in fact, the hum level was completely independent of the position of the head relative to the turntable.

This pointed to the third — and most likely — cause: a hum loop involving the turntable power lead. Sure enough, inspection of the underside of the player revealed the classic hum loop situation, as illustrated in Fig. 1.

Four fine leads from the base of the pickup were terminated on a 3-lug tagstrip, the two "earthy" or common leads going to the centre lug. This lug was extended in the usual way to provide a foot which was bolted to the frame of the player. From the tagstrip a length of shielded twin wire was provided for connection to the amplifier, the braid being soldered to the centre lug.

Modern high quality turntables such as this Sony unit are extremely unlikely to be plagued by hum problems. Owners of older units may not be so fortunate.

Fig. 1 also indicates the power wiring underneath the player deck. Ignoring the off-on switch, wires from the motor ran to a junction block, which also terminated the incoming 3-core power flex. The earth wire was anchored to a lug bolted to the player frame. Electrically the manufacturer had done the right thing, but not without implications in regard to the signal circuit.

Tracing the path from pickup to amplifier, signals from the cartridge first reached the 3-lug tagstrip, at which point the two "earthy" leads joined together and made contact with the frame of the player. From here they ran to the amplifier through a shielded twin pair, with the braid providing common path for the "earthy" side of both cartridge elements. In isolation, this connection would not normally have involved any problems.

However there is another return path for the signals, paralleling that provided by the metallic braid. It runs from the centre lug of the 3-tag strip, through the body of the player to the lug to which the motor wiring is bonded. It then runs through the 3-core power flex to the power point earth, and wiring, and from here back through the amplifier power cord to the amplifier. Inside the amplifier it bonds to the chassis at some point adjacent to the power supply, finding its way back to the actual signal input circuit via the internal metalwork and wiring.

There are thus two distinct paths by which signals can be conveyed to the amplifier input: one intentional and direct, the other via the power wiring. When this occurs there is a strong chance that stray hum components present in the power wiring will find their way into the signal circuit and this, in fact, was what was happening.

Considered another way, the two earth paths may be regarded as forming an "earth loop".

Starting, say, at the centre lug of the 3-tag strip, one can trace a continuous path through the power cord to the power point, through the second cord to the amplifier chassis and thence back to the tagstrip via the braid. It constitutes a large single-turn loop, into which currents can easily be induced from stray fields surrounding power wiring, power transformers, &c.

It is this induced current and voltage which can get into any low-level signal circuits associated with the hum loop.

Use of the term "low level" in the preceding paragraph is significant. The kind of wiring described might not lead to any problems in a player fitted with a crystal or ceramic cartridge, because the induced hum voltage would be very small in comparison with the signal from the car-

tridge and the input sensitivity of the amplifier.

But with a magnetic cartridge having an output of only a few millivolts, and with a high-gain amplifier to match, small hum voltages induced in an input earth loop can be quite sufficient to produce an audible hum in the loudspeakers.

Fairly obviously, the earth loop situation in Fig 1 can very simply be interrupted by disconnecting the earth link from the power point to player frame — an easy way out and one that is often taken.

In fact, overseas record players are often manufactured on the assumption that only a twin power cord will be used. The problem of the earth loop arises when a 3-core flex is fitted, in accordance with Australian safety practices.

The chance of receiving a traumatic shock from a record player in a domestic hifi situation is probably quite small but the fact remains that elimination of the earth link to the power point does leave open the possibility. The fine earth braid back to the amplifier input can scarcely be regarded as affording significant protection, since it would be just about as likely to "blow" as the fuse in the event of trouble.

In many cases it will be found that the motor itself is insulated from the frame of the player, being hung in rubber grommets and driving the turntable through a non-conducting belt or pinchwheel. If this is so, the frame of the motor can be earthed separately to the power point, leaving the rest of the metalwork to be connected to the amplifier.

While this offers adequate protection against an insulation breakdown in the motor, it does not protect against breakdown in the off-on or auto-stop switching. However, it may be possible in such a case to bond the player frame to the amplifier chassis with a fairly stout lead, without running into troublesome earth loop problems. The amplifier earth would then provide earth protection with the equipment set up for normal operation.

By far the best approach, however, is to leave the earth wiring to the power point intact and to modify the wiring to the pickup, so that the "earthy" side is completely independent of the metalwork of the player.

In the simplest terms this would merely involve replacing or supplementing the existing tagstrip to provide another anchor point for the earthy side of the pickup wiring, which would be insulated from the player baseplate. Provided the wiring from the cartridge was completely independent of the headshell and arm and provided a plastic sheathed output cable is used, there can be no contact between the signal circuit and other metalwork and therefore no risk of an earth loop.

In fact, having become involved in modifications, there is good reason to go the whole way and to wire the pickup output circuit as shown in Fig. 2.

A tagstrip is required which will provide insulated terminations under the player for all four leads from the cartridge and, preferably, for the shield braids. Insulated and shielded twin leads should be provided for connection to the amplifier. The free ends must, of course, be fitted with the appropriate connectors and here the braid can be joined to the earthy side of the respective channel inputs.

Wired thus, there will be no connection between the signal circuit and the player frame, and the output from each half of the cartridge will be earthed only at the input point to the amplifier.

Not only does this avoid any kind of earth loop but it also has another potential advantage. The leads to each half of the cartridge are symmetrical and remain very close together inside a shield braid. Any hum field in the vicinity will tend to induce similar and in-phase currents in the two wires; and since the wires are virtually in series with the signal path, the currents will tend to cancel.

It is exactly the same kind of thinking which is applied to balanced and shielded microphone cables.

If there is a special reason to do so, the braid could be earthed to the frame of the player and not commoned at the amplifier end. Again, a 4-lead single-shield cable could be used with the braid earthed either at the player end or the amplifier end. There may even be cases where the braid could be used to advantage to link the player frame to the amplifier.

The important point, however, is to run the pickup wiring right through to the amplifier and to avoid having the braid as part of the signal carrying circuit.

Three possibilities occur to the writer which might complicate the intention to eliminate hum loops.

The first is the possibility of the cartridge carrying a link between the earthy pins and an outer metal shell. This could establish a contact with the player body via the headshell and arm. If this link can be dispensed with, do so; but otherwise it can negate efforts to isolate the pickup wiring from the player frame.

A second possibility is some kind of a link between the pickup wiring and the arm where the head or head shell plugs in. This link should be broken if at all possible to isolate the signal circuit. If not otherwise grounded, the headshell and pickup arm should be bonded to the motor frame and earthed back to the power point.

The remaining and most difficult problem occurs if the wiring from the cartridge through the arm is run in fine non-insulated shielded wire. The braiding, connected to the respective halves of the cartridge, is free to contact the inside of the arm and the vertical bush on which the arm rotates.

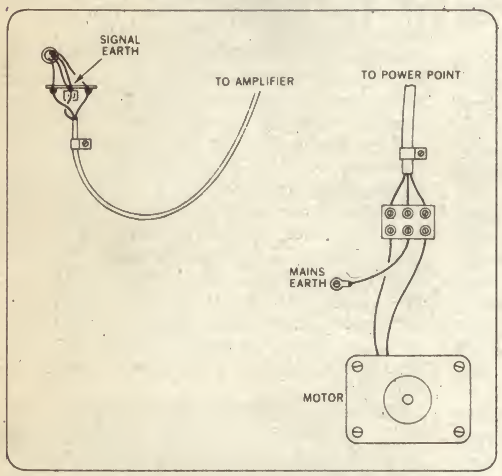
It may be possible to replace the shielded wire with four plain leads but these must be extremely fine and flexible (as used in other pickups) otherwise they will stiffen the movement of the arm both vertically and horizontally.

If the leads cannot be changed for any reason, the options become rather limited:

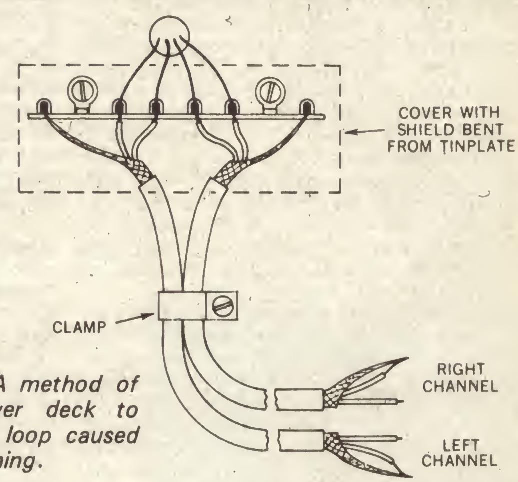
- Retain the earthing to the power point and put up with the earth-loop hum;
- Eliminate the earth wire and the hum loop but forgo the protection that the earth wire affords against possible faults in the mains circuitry.
- Insulate the arm from the rest of the motor mechanism — simple with a wooden baseboard, but difficult with a metal baseplate. If this is done, the arm will be grounded via the signal wiring and the rest of the mechanism via the power flex.
- Eliminate the earth connection via the power point but bond the player frame effectively to the amplifier chassis, earthing the whole through the third wire in the amplifier power cord. This does not eliminate the earth loop problem but it does minimise it. The approach makes most sense when the phono motor picks up its power from the amplifier (via a built-in AC outlet) or from the same power point; this way, power to the motor is cut off when the amplifier plug is withdrawn.

A rather tedious business? We completely agree.

But then, a persistent background of hum in a hifi system is also rather tedious and trying. If you can eliminate it by the means outlined in this article, you will almost certainly judge the effort to have been worthwhile!



LEFT: Fig 1, showing the wiring situation likely to be found under a player deck when hum problems exist.



RIGHT: Fig 2. A method of rewiring a player deck to eliminate a hum loop caused by multiple earthing.

An Electronic Steam Whistle

Our "Electronic Steam Whistle" was developed with the model railway enthusiast in mind. It might also serve as a sound effects simulator for amateur theatricals. Featuring single and dual horns, with background steam, it will add realism to your model setup. A separate "Noise" outlet is also provided to simulate steam alone.

by GERRY NICHOLSON

A series of articles describing a sound effects simulator for electronic organs was published in the October, November and December 1971 issues. The steam whistle described in these articles inspired us to produce this unit. In fact, we started off with an exact copy of this circuit. Our impression of this arrangement was that, while it would no doubt be adequate as an organ sound effect, it did not provide the flexibility which a model railway enthusiast would be likely to require. However, it provided a good starting point.

We considered it essential that all the factors affecting the final sound should be capable of being varied over a wide range; preferably a wider range than appeared to be strictly necessary. This would permit the builder to vary any or all of these factors, as he thought fit, in order to achieve what he considered the best imitation of the particular whistle he had in mind.

If we consider the type of sound a steam whistle makes, we will be in a better position to decide how we can imitate it electronically. For a start, when the steam valve is opened, the sound intensity appears to rise to a constant level over a short period. In other words, it has a certain rise time. Also, during this rise time, the frequency of the whistle falls slightly.

Now consider the effect as the steam valve is closed. The steam in the whistle will take a short period to escape (as the pressure drops), thus the sound intensity fades over a short period. In other words the whistle has a certain decay time. Another feature peculiar to whistles is the background sound of the steam or air which operates them. As mentioned earlier, our device also features dual horns. This type of sound is usually produced by air horns, the two horns having a frequency ratio of about 1.5 to 1.

We must now design circuitry which will imitate the above features. To avoid confusion, we shall forget the dual horns for the present. To produce the single whistle, we require an oscillator. A simple phase shift oscillator would appear to be suitable. (TR1 and associated components). There are no inductances required, and the frequency can be varied easily by changing resistance or capacitance.

To simulate the steam, a logical choice is a white noise generator. This is merely a reverse biased diode, arranged so that avalanche takes place, producing a substantial amount of noise. We use a reverse biased BC108 (D3) emitter to base junction in this mode.

Initially, we tried mixing the output from the noise generator directly with the oscillator output, but we were not happy about the level of noise available. It may have been sufficient in some cases, but it was a marginal condition. Accordingly, we fitted the noise amplifier (TR3) which provides more than sufficient noise for any likely requirement.

The signals from the oscillator and noise generator must be mixed in the correct ratio before they are fed to the main amplifier, and they must only reach the input to this amplifier when we wish to initiate the whistle. Also a means to vary the rise and decay times of the signal must be devised. All these functions are conveniently performed in the gated amplifier stage (TR4).

The whistle and noise signals are mixed at the input to the gated amplifier. The ratio of these signals is adjusted by resistance in series with the coupling capacitors from these stages.

The gated amplifier is normally gated off by a voltage divider network consisting of the 4.7k in the emitter circuit and the 47k to the positive rail. To gate the amplifier on, in the simplest case, it would be sufficient to shunt the emitter resistor with another resistor of suitable value. However, we can provide the required attack and decay times by adding suitable time constant circuits which control the rate at which the stage is gated on or off.

The time constant circuits consist of the 1k and 2.2k resistors and the two 10uF electrolytic capacitors in the emitter circuit of TR4. The total resistance of 3.2k is that required to gate the amplifier on, but the rate at which this can happen is determined by the rate at which the capacitors can be charged or discharged through their associated resistors. The 10uF capacitor across the 4.7k emitter resistor also functions as a conventional by-pass to maintain the amplifier gain.

When the test button is pressed, the lower leg of the voltage divider to TR4 emitter becomes approximately 1.9k ohms. However, before the stage is biased on, the emitter bypass capacitor must discharge through the emitter resistor in parallel with the gating resistance, and the other electrolytic must discharge via the 1k resistor.

Thus the output of the gated amplifier rises to a constant level over a short period, as the electrolytics discharge. We have thus introduced the necessary rise time. This rise time can be increased by increasing the capacitance of either electrolytic, or the gating resistance, and vice versa for a decrease. Note: If the gating resistance is increased too much, the stage may not bias on at all, thus it is preferable to vary only the capacitance if it is desired to change the rise time.

These electrolytics also provide the decay time. When the test button is released, the emitter bypass capacitor charges via the 47k, while the other electrolytic charges through the 2.2k before the gated amplifier is biased off. Thus the output from this amplifier fades over a short period. The rise and decay time adjustments interact, thus a compromise must be accepted, but more about this later.

Earlier we mentioned that a steam whistle appears to lower pitch during the rise time. The method we used to achieve this effect is as follows. The gated amplifier output signal is fed via a 0.22uF capacitor to a rectifier (D2). The DC thus produced is proportional to the output signal amplitude and, therefore, increases during the rise time. However C2 (DC reservoir) must charge before a constant negative potential exists, thus the value of C2 controls the rate at which this potential increases.

In OSC1 a BA100 (D1) is connected in series with an 82k from TR1 base. Normally D1 is biased on, thus the 0.0047 is shunted by 82k. Under these conditions the oscillator frequency is approximately 780Hz. If the DC control voltage is now applied to the anode of D1 via a 2.2k, this diode will be biased off. The effect of the 82k as a discharge path now becomes negligible, thus the overall phase shift of the network increases, and the frequency settles at approximately 750Hz.

OSC2 was added to provide the dual horn feature. In this mode, SW2b disables the DC control voltage, thus OSC1 operates at approximately 750Hz continuously. Meantime SW2a switches the 2.2M in series with the OSC2 coupling capacitor to the gated amplifier base. Now when the test button is pressed, we hear the dual tone plus noise. The rise and decay effects still occur, but there is no frequency shift. The final frequency of our second oscillator was found to be approximately 490Hz for the most realistic dual sound.

The 10k preset pot in one leg of the OSC2 phase shift network was included to allow the frequency ratio between oscillators to be finely adjusted, but more about this when we discuss final testing.

Construction should not present any serious problems for the average reader with some previous experience. While the finished product may look a little complicated, it must be remembered that it is a collection of separate sections. To make things easier, we have described the construction on a section by section basis, with details of how to test each section before proceeding to the next one.

We constructed the two oscillators on a piece of tag board, 17 pairs of terminals long. The noise generator, noise amplifier, frequency shift network, and gated amplifier are built on a second length, 19 pairs long. We suggest the oscillator board be wired first but, if the dual horn facility is not required immediately, the OSC2 section may be omitted for the present. To allow the tag boards to fit into the small case we chose it was necessary to limit the number of tags on each board. This made it necessary to place some components on the underside of each board.

Two threaded pillars hold the tag boards apart, while another two secure the whole assembly in the case. We cut the heads off two 1/8 Whit. screws and used these as studs to sandwich the oscillator board between the pillars. Take care that no components are placed where the pillars are to be located.

If one follows the circuit and wiring diagrams, wiring OSC1 should be relatively straightforward. There are only two components under the board, the 82k and the 25uF electrolytic. Where a capacitor or resistor is soldered to tags which have at least one other tag between them, the pigtails of that component should be insulated with spaghetti, to eliminate any possible shorts. Also insulate the pigtails of those components under the board. With this section wired, check it against the OSC1 section of the circuit, and the wiring diagram.

At this stage, OSC1 can, and should, be tested. Testing will call for an amplifier or, better still, an oscilloscope. As a last resort a high impedance headphone will suffice. Connect an 18V positive battery terminal to the free end of the 1k resistor and the negative terminal to the negative rail. Connect the 820k resistor to the the amplifier, oscilloscope, or headphone, either of which should indicate a sine wave output. It must be realised, however, that much of the realism is still missing. Do not make a final judgment until the noise (steam), attack and decay, and frequency shift have been added.

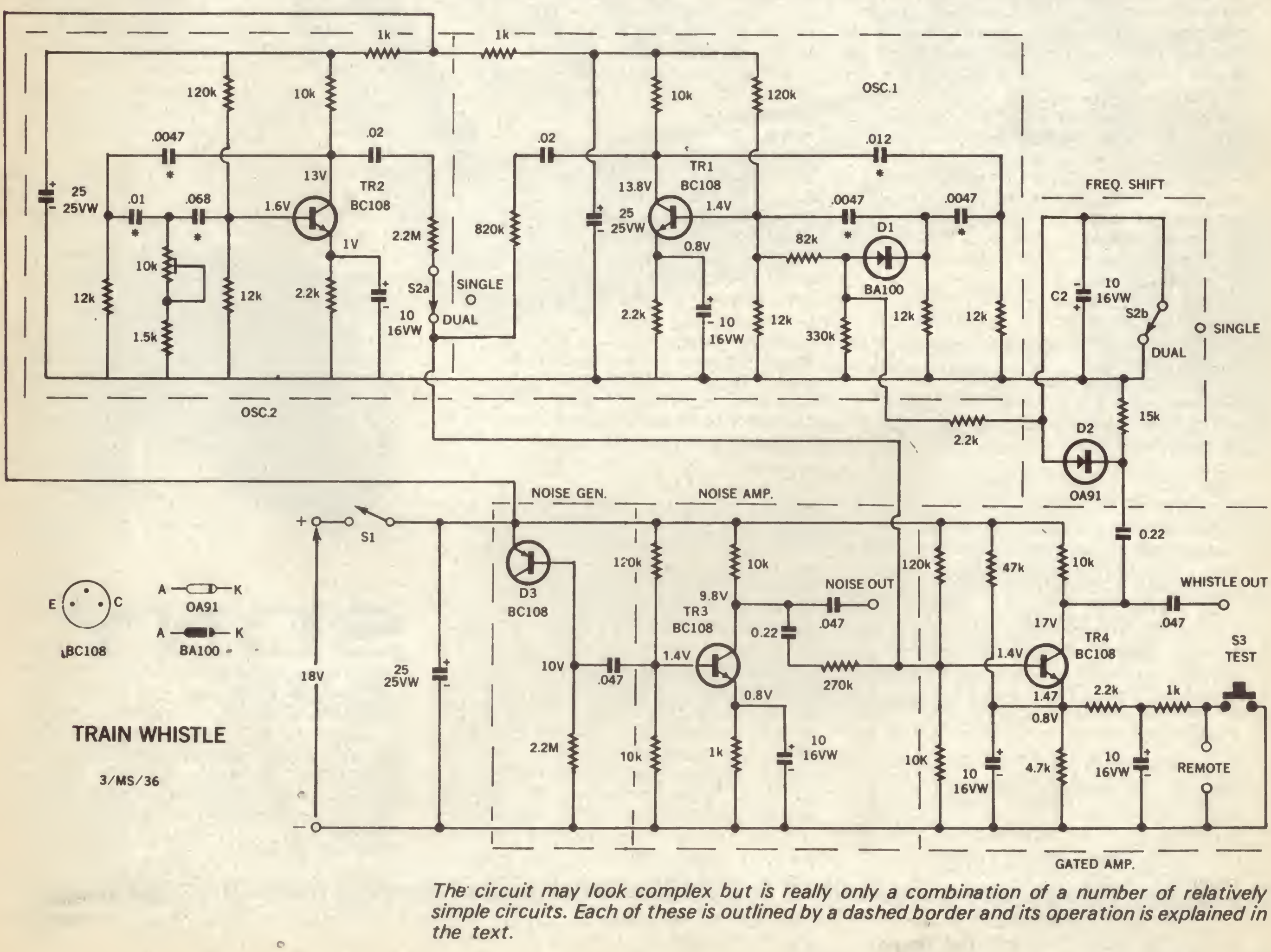
OSC2 occupies the rest of this board. The same procedure as that described for OSC1 applies to this section. The only extra component is the 10k preset pot, although the phase shift capacitor values have been changed to lower the frequency. One of these capacitors (.068uF) is situated under the board, along with the 25uF electrolytic, and a 1.5k and a 2.2k resistor.

To complete this board, interconnect the oscillator negative rails with a short length of wire as shown on the wiring diagram.

OSC2 can be tested in the same manner as OSC1, but Rv1 should be varied during the test, to ensure that the pitch of OSC2 does vary noticeably with this adjustment.

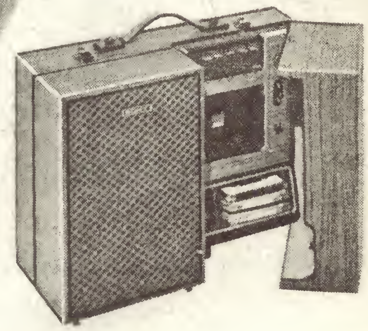
To begin the second board we can wire the noise generator. This section has only three components, so it should not take long to complete it. The collector of the BC108 is not used, so simply bend this lead up out of the way.

The noise amplifier is logically situated next to the noise generator. The 10uF emitter bypass is the only component under the board. The positive rail for this section is via a wire to the emitter of the noise generator transistor. Once again the sections should be checked against the circuit



The circuit may look complex but is really only a combination of a number of relatively simple circuits. Each of these is outlined by a dashed border and its operation is explained in the text.

15 watts that really move!



The TC-133CS is Sony's newest portable music machine — a stereo cassette-corder that really goes places. It doubles as a tape deck if you wish, features 4 track stereo 2 track mono recording and playback with powerful 15W output. Low distortion and all silicon transistor amplifier. Extended frequency response thanks to ITL (Input Transformerless) and OTL (Output Transformerless) circuitry. Tape selector for high performance chromium dioxide tape or regular ones • Can be used as a deck — removable hand grip for home decor • Impedance for 8-ohm or 10k-ohm stereo headphone • Tape mode indicated by tape pilot lights — Red on REC, Green on PB, FF, REW, STOP • Walnut-finished cabinet • Magnetic cartridge input . . . for enjoying a record player • Speaker switch; on/off on PB, monitor level on REC • Two record level meters, input select switch, stereo/mono switch • Very compact and lightweight for easy portability. Specifications for the money, it's amazing value.

SONY

JACOBY KEMPTHORNE

SYDNEY: 26 2651, MELBOURNE: 329 6866, ADELAIDE: 93 2388/9, BRISBANE: 44 4488, PERTH: 28 5725, LAUNCESTON 2 5322. Agents: CANBERRA: 47 9010, NEWCASTLE: 61 4991, FAIRY MEADOW: 84 8022.

For further information please fill in the Reader Information Service coupon in this issue

SN4240

before testing.

To test the noise generator and amplifier, connect the positive 18V battery terminal to the emitter of the noise generator transistor (used as a diode), and the negative terminal to the negative rail. Connect the free end of the .047uF capacitor (labelled Noise Output) to the input of your amplifier or oscilloscope. If there is no output, place a fairly large value capacitor in series with the amplifier input lead and check if there is output from the noise generator at the amplifier base.

The rest of this board accommodates the gated amplifier and frequency shift network. The lk gating resistor mentioned earlier is the only component under the board. Make sure that the negative end of C1 (refer to frequency shift network) connects to the OA91 anode. A short length of wire from the gated amp collector to the 0.22uF capacitor (shown on the wiring diagram), and another length to connect the negative rail, completes this board. Check the complete section against the circuit and wiring diagram.

The gated amplifier can be tested using the amplifier or oscilloscope, as for earlier tests. Until the test button is pressed, there should be no output from the gated amplifier, although there will be signal at the base of TR4 continuously. The emitter voltage under these conditions should be approximately 1.47V. When the test button is pressed, there should be output, and the

Parts List

1 Metal box 5¼in (135mm) x 3⅛in (79mm) x 2⅛in (54mm)
2 Belling Lee chassis sockets, L604/S
2 Belling Lee plugs L734/P
1 2 pin speaker socket and plug to match
1 Miniature toggle switch
1 Miniature toggle switch, 2 pole 2 way
1 Miniature pushbutton switch, normally off.
1 length miniature tag board, 17 pairs of tags.
1 length miniature tag board, 19 pairs of tags.
2 9V batteries, type 216 or similar
2 clip connectors to suit above.

RESISTORS (½ watt)

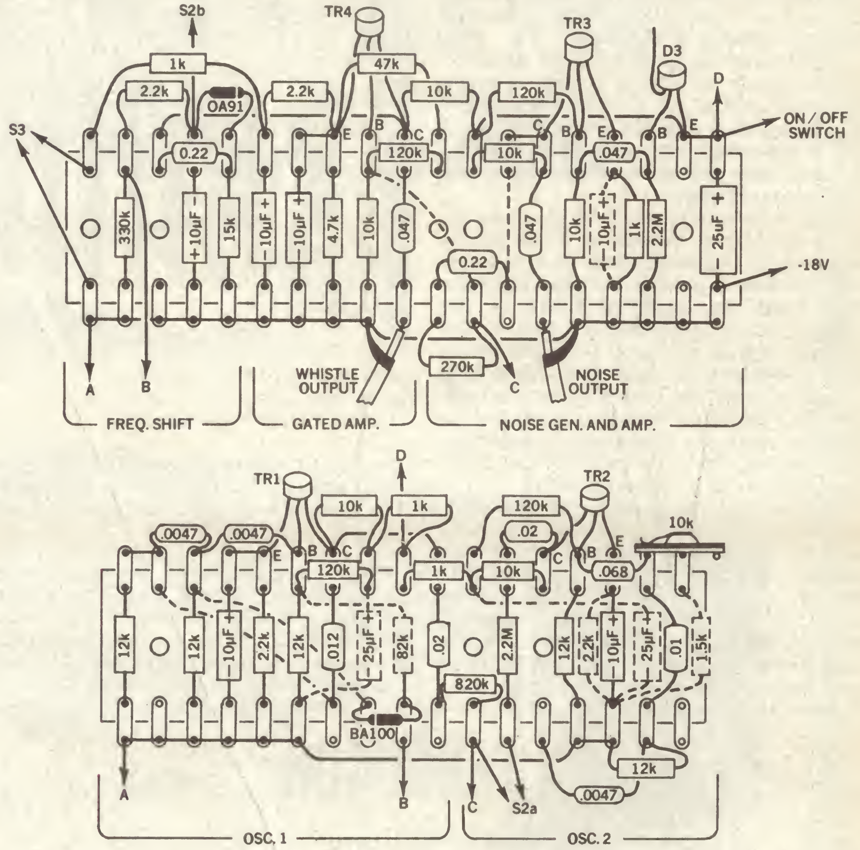
2.2.2M	*1 15k*
1 820k	*6 12k*
1 330k	*6 10k*
1 150k	*1 4.7k*
1 270k	*4 2.2k*
4 120k	*1 1.5k*
1 82k	*4 1k*
1 47k	

1 10k preset miniature pot.

SEMICONDUCTORS.
5 BC108 transistors, or equivalant.
1 BA100 silicon diode.
1 OA91 diode.

CAPACITORS.
Electrolytics.
3 25uF 25VW, 6 10uF 16VW.
Miniature Polyesters (100VW).
2 0.22uF, 3.047uf, 2 .022uf, 1 .01uF, 3 .0047uF.
Polyesters (160VW)
1.068uF, 1 .012uF.

MISCELLANEOUS
12 ⅛in Whit. RH screws. 4 ½ in threaded pillars (⅛in Whit.).
Nuts and washers. solder lugs. foot of single core shielded cable.
hookup wire.
1 rubber grommet to suit ¼ inch hole.
20 gauge tinned copper wire.
Length of 2mm sleeving.
4 No 4 self tapping screws ¼ inch
Adhesive Lettering.
NOTE: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with higher ratings may generally be used providing they are physically compatible. Components with lower ratings may also be used in some cases, providing the ratings are not exceeded.



Wiring diagrams of the two boards. The function of each section is clearly shown. The upper board is the one visible in the photograph on page 35. The lower panel is mounted below it.

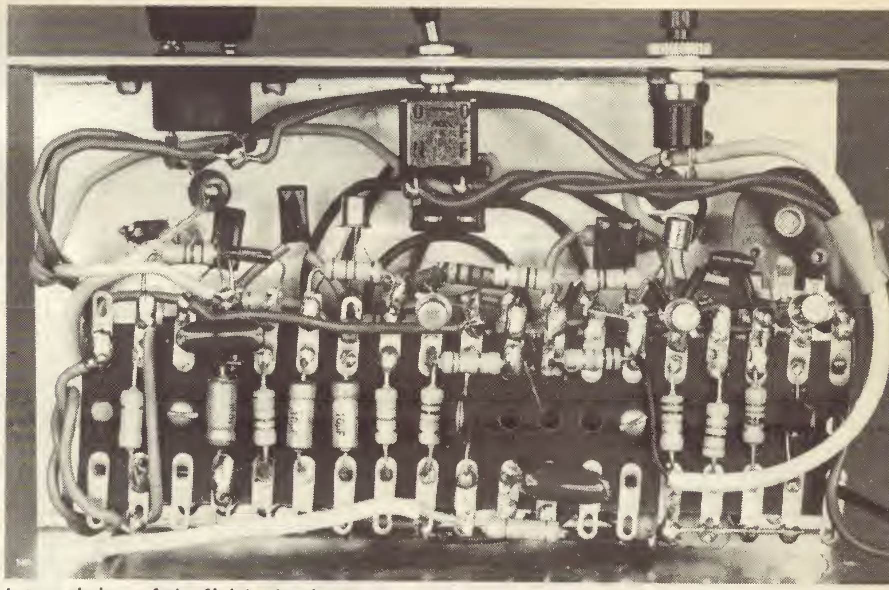
emitter voltage should be approximately 0.8V.

If the output is observed on a CRO, there should be some distortion obvious, one half cycle being more rounded than the other. This is deliberate, and adds a little to the realism of the sound. The background noise (steam) should also be obvious as "grass" superimposed on the waveform. If only an amplifier is available, simply check that the stage gates on and off correctly, and that the level of noise is adequate.

The rise and decay of the ouput signal is relatively fast, so if there is need to prove that these effects are present, remove the two electrolytics from the emitter circuit of TR4. If the gate is now opened there should be a noticable difference in the attack and decay characteristic.

Four wires interconnect the two boards. Make these long enough to allow future access to the boards should it be necessary. If the two boards are fastened one above the other (with the oscillator board on the bottom) using the threaded pillars, the assembly should sit rigidly while the flying leads are soldered. Make these leads long enough to allow the boards to be removed from the case while the unit is operating, to allow for service or adjustment. Connection from the boards to the whistle and noise outlet sockets is by shielded cable.

While we have mounted the complete unit in a metal box, and some readers may elect to do the same, this is not essential. Other readers may prefer to wire the boards directly into their existing model railway electrical system, with leads running directly to the various ancillary devices. For those who wish to use a metal box similar to ours, and have the facilities to make their own, we can supply a dyeline print for $1.00. These will also be distributed to the chassis manufacturers, so that ready made boxes should be available.



Internal view of the finished unit. The two boards are stacked one above the other and the lower one is just visible. At the top of the picture are the remote socket (left), the on / off switch and the test button.

Those who make their own boxes should be particularly careful in positioning the mounting holes for the boards. Any serious error here may locate the terminals on the boards too close to the metal side of the box, with consequent risk of short-circuits.

The train whistle should now be complete, apart from final testing and adjustment. As in the case of the initial tests, an 18V battery is required, conveniently made up from two nine volt batteries as specified in the parts list. Output from the whistle is approximately 500mV PP across 50k ohms, so the amplifier it is to drive need not be particularly sensitive. If the amplifier is very sensitive, it would be advisable to place a 50k preset pot across the whistle output, and adjust the output to a level which does not overload the input stage of the amplifier. The noise output socket should also give approximately 500mV across a 50k ohm load.

Connect the whistle output to the input of the amplifier via a suitable lead. Switch to single horn, and press the test button. The whistle pitch should fall as this button is pressed. The rise and decay effects may not be so noticeable, as they are much faster, but if they are eliminated the difference will be obvious. The whistle should be accompanied by background "steam".

If the whistle to steam ratio is not suitable, the 820k (whistle) or the 270k (noise) resistors connected to TR1 base can be changed. More resistance for less noise or whistle and vice versa. The oscillator pitch can be varied by changing any of the capacitors in the OSC1 phase shift network. These are marked with asterisks. More capacitance lowers the pitch and vice versa. If the pitch or whistle to noise ratio is altered it must be appreciated that OSC2 pitch or output must also be altered.

If C2 is increased, the rate at which OSC1 changes pitch will be decreased. If the 2.2k connecting to C2 is increased, the amount by which it changes pitch will be decreased.

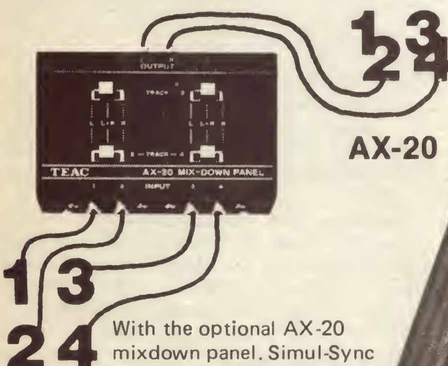
As mentioned earlier, the rise and decay time settings interact to some extent. If both the electrolytic capacitors in the TR4 emitter circuit are increased in value by the same amount, the rise and decay times will increase together, and the ratio between these times will remain relatively constant. Likewise if both capacitors are lowered in value the rise time and the decay times will decrease.

TEAC's new multi-track decks are the fourmost.

TEAC was the first to introduce four-channel decks, long before any others were around. Now we introduce the incomparable A-3340: destined to be the fourmost.
A proven pro, this deck combines the best features of TEAC's forerunners. At first glance, you're struck by its audio sophistication. It's professional 10½" deck with 15 and 7½ ips speeds, and it delivers "four-in-hand" versatility. TEAC's Simul-Sync system for recording individual instruments separately at any time, all in perfect sync. Added to its "one-man-band" recording ability, the 3340 records superb four-channel stereo, as well as regular two-channel stereo and ¼-track mono.

TEAC® A SOUND IDEA

Australian Distributors:
Australian Musical Industries Pty Ltd
155 Gladstone St.,
South Melbourne Vic. 3205
Ph. 69-7281
619 Pacific Highway,
St. Leonards, NSW 2065, Ph. 439-5752



With the optional AX-20 mixdown panel, Simul-Sync recording can be dubbed down to two-channel stereo or mono demos

If you prefer slightly less four-channel sophistication, take a look at our new A-2340. It's like the A-3340 but with 7½ and 3¾ ips speeds, and takes 7-inch reels.
If you want the fourmost, you owe yourself the best—a TEAC A-2340 or A-3340.

If you'd like to know more, write to us for the TEAC Catalogue, price list and franchised dealer list.

AMI 142

Low cost Scaler extends digital counters to 200MHz

Here is a new design which should be of special interest to lab workers, mobile two-way radio technicians and VHF radio amateurs. It is easily built at low cost, and uses a state-of-the-art ECL integrated circuit to extend the range of your present DFM or counter to beyond 200MHz.

by JAMIESON ROWE

Back in the March 1969 issue, you may remember, I described our first frequency scaler to extend the range of existing digital counters. It used some of the first emitter-coupled logic (ECL) integrated circuits, which had then just been released. By using some seven of these devices I was able to achieve a maximum frequency of slightly more than 120MHz, with a division ratio of either 10:1 or 20:1 to cope with counters with maximum counting rates as low as 6MHz.

The performance of the 1969 design was considered quite good at the time, particularly in view of its modest cost, and many of the units were built up. They have been used in many research, development and teaching laboratories as well as by mobile radio technicians and VHF radio amateurs. However, integrated circuit technology is progressing at a very high rate, and it is not surprising that since the original unit was developed, higher performance devices have been produced.

This fact made itself evident some weeks ago when I was looking through literature describing some of the recently released devices. Despite the relatively short time that has elapsed since it was described, the 1969 scaler is now well and truly obsolete. Hence the reason for developing the new design described in this article.

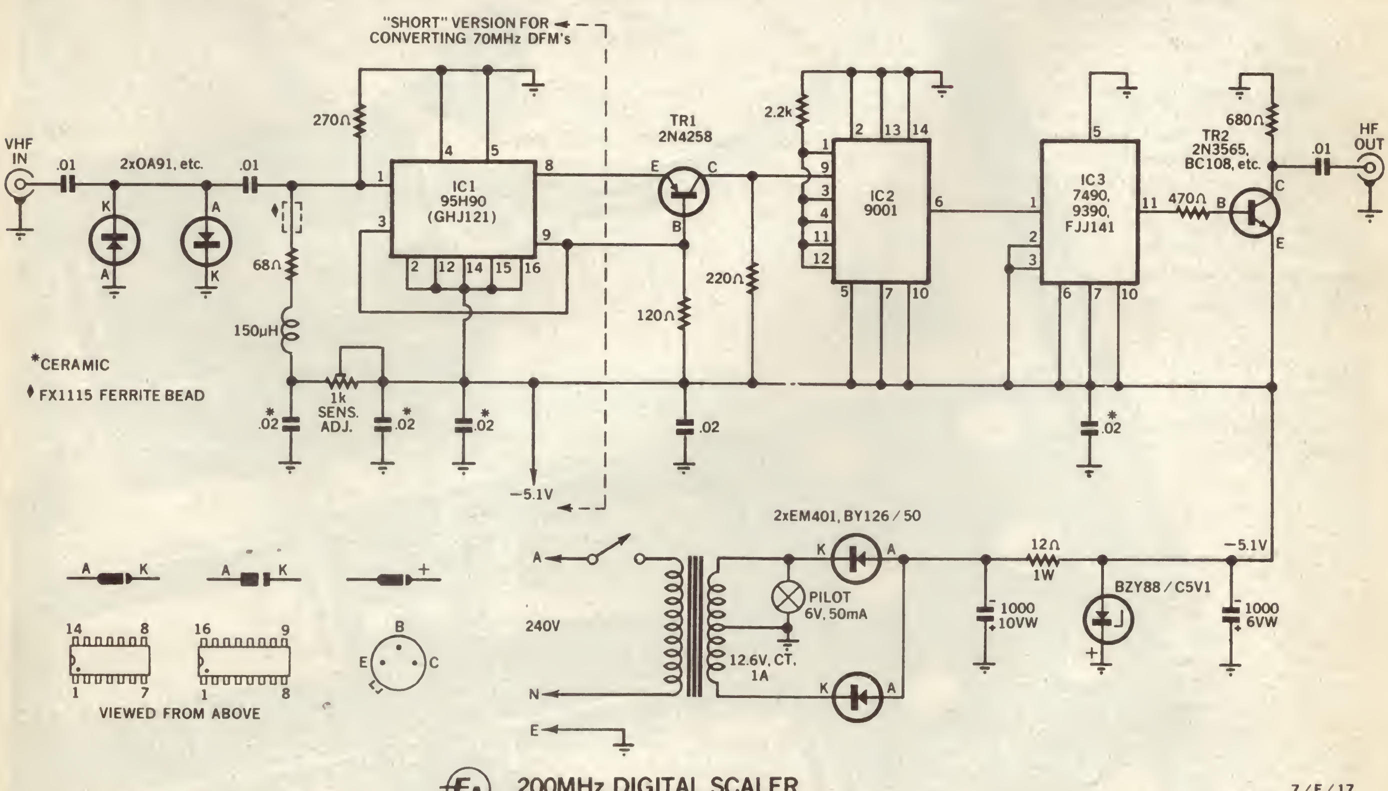
The new scaler is completely different from the old one in terms of circuit configuration. It uses only three ICs, two transistors and five diodes — three of which are in the power supply. In terms of cost and complexity, it should be both cheaper and easier to build than its predecessor.

Yet at the same time its performance is significantly improved. The upper frequency limit is now slightly above 200MHz, thus extending well past the 144-148MHz amateur band and the upper VHF mobile radio band. The frequency division ratio is now 100:1, so that the scaler will extend to 200MHz any counter capable of counting up to 2MHz at present.

Input sensitivity is high, less than 800mV peak-to-peak input being required for reliable division up to 200MHz. Input impedance is low, approximately 50 ohms, but at VHF this is generally no problem. In most cases a small "sniffer loop" or length of wire for capacitive pickup at the end of the input cable will be quite sufficient. The input is protected from overload damage.

Output from the scaler is approximately 4.5V peak-to-peak, with a low output impedance. This should be more than adequate for all but the most insensitive counters.

Basically the scaler consists of two cascaded decade divider stages, a very high speed input stage followed by a lower speed stage. If the unit is to be used with a counter having a basic frequency capability of 20MHz or better, the second decade may be omitted, reducing the cost and simplifying the unit still further.



The circuit of the scaler, which uses only three ICs and two transistors.

In this "shortened" form the scaler may easily be built into the existing 70MHz frequency meters made to my design published in the May and June 1970 issues, to convert them at low cost into full 200MHz instruments. This is a simple procedure, and is described later in the article.

Heart of the scaler in both its "long" and "short" versions is a new ultra-high speed ECL decade divider IC, which performs the input divider function. This device is the Fairchild Semiconductor type 95H90, for which Philips Elcoma also have an equivalent, type GHJ121.

The 95H90 is a medium-scale integration (MSI) device which contains four very high speed J-K flip-flops. These use ECL circuitry and are arranged for either BCD decade counting, 10:1 frequency division, modulo-11 counting, or 11:1 frequency division. It has a guaranteed minimum input counting rate of 220MHz, and typical devices can exceed 300MHz in a suitable circuit configuration.

Here the device is used for straight 10:1 frequency division, and the simple circuit configuration tends to limit operation to about 210MHz.

The 95H90 is not a cheap device, costing around $15 plus tax. However as it needs only the addition of a few minor components to provide a full 200MHz-plus counting or divider decade, it is still significantly cheaper than any other alternative approach.

The input of the scaler connects to the input of the 95H90 via two coupling capacitors in series, with the junction of the capacitors connected to ground via inverse-parallel diodes. These protect the 95H90 against input overload damage.

A DC bias voltage is also fed to the input of the device to set the conditions for maximum input sensitivity. The bias circuit is decoupled by a ferrite bead and a small RF choke. Without these components, spurious coupling back through the supply line tends to degrade the 95H90 performance and reduce the maximum frequency of operation.

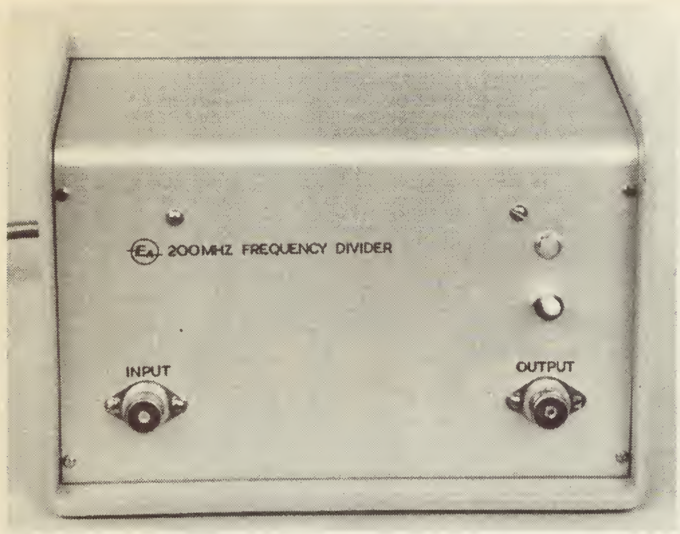
The second decade of the scaler uses TTL (transistor-transistor logic) devices: a 9001 and a 7490 or 9390 or FJJ141. The 7490 / 9390 / FJJ141 is actually a full MSI decade divider itself, but with a guaranteed maximum counting rate of 10MHz. Used alone for the second decade, it could in the worst case limit the upper frequency of the scaler to 100MHz. For this reason the input flip-flop of the device is left unused, and a type 9001 flip-flop IC used instead. With a typical maximum counting rate of 50MHz, the 9001 ensures that the upper frequency limit of the scaler is set solely by the 95H90 input device.

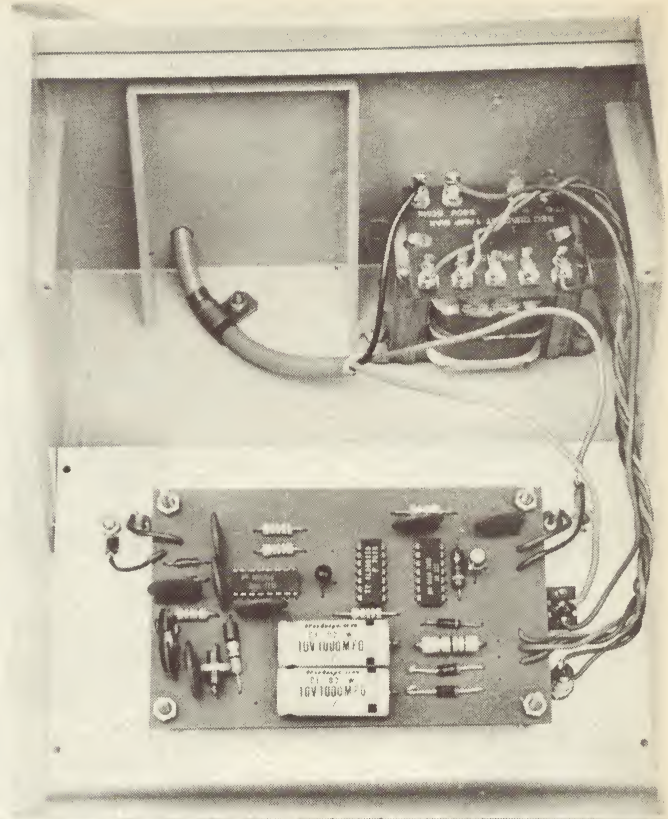
Because the second decade uses TTL devices whose logic levels are different from those of ECL, level translation is required between the two stages despite the operation of both from a common positive-ground 5V supply. The translator used is a simple inverter using a 2N4258 very high speed PNP switching transistor.

To prevent disturbance of the second divider decade due to output loading, a buffer stage is used between the 7490 and the output connector. The buffer uses a 2N3565, BC108 or similar general-purpose NPN silicon transistor.

Power for the scaler circuits is provided by a simple supply using a full-wave rec-

Hi Fi STEREO





Above is a view of the completed scaler unit, while an inside view is shown at right. The printed board mounts on the rear of the front panel.

tifier connected to a centre-tapped 12.6V transformer winding. A 400mW zener diode is used to stabilise the supply to the ICs to a nominal 5.1V. The current drain of the scaler circuits is approximately 210mA.

With the exception of the power transformer, mains switch, pilot lamp and input / output connectors, all of the scaler components and wiring are mounted on a small printed wiring for ease of assembly. The board measures 4½ x 2¾in (114 x 70mm) and is coded 72 / s10.

The prototype of the "long" version of the unit was built in a small plastic-and-aluminium instrument case, type ATCP, made by the Australian Transistor Company and distributed by Watkin Wynne Pty Ltd. This case is available from most trade suppliers, and allows the scaler to be built up conveniently and rapidly.

Inside the case the printed board is attached to the rear of the front aluminium panel, via four 1¼ x ⅛in Whitworth screws with multiple nuts used for spacing. The lower two screws are also each used to fasten one side of the input and output connectors, to reduce the number of screw heads visible on the front panel. The power transformer is mounted on the bottom of the plastic case, as far to the rear as possible to provide maximum clearance between it and the wiring board.

The prototype "short" version of the scaler has been built into the original 1970 70MHz digital frequency meter. Here it simply consists of the "front half" of the board, mounted in the DFM in place of the small board originally used to perform 2:1 input frequency division. The scaler board is simply sawn in half along a line drawn between two "notches" which have been provided for this purpose in the etched copper pattern. The notches are approximately midway along the long edges of the board.

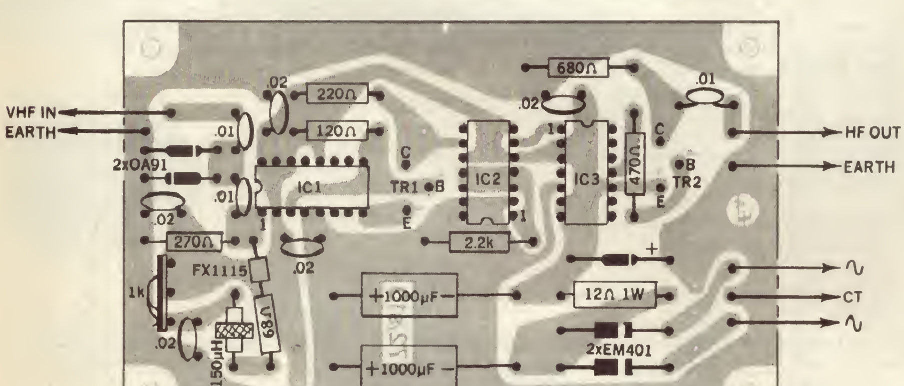
The scaler board has been designed with its width the same as the small divider board in the original DFM, and with its mounting hole centres also the same. It is therefore a simple drop-in replacement.

Because the input gate and first counting decade of the 1970 DFM already use ECL devices, there is no need for the scaler's logic translator stage. Thus in this short form the scaler consists simply of the 95H90 device and its power supply and input biasing components. It is powered from the —5V supply already provided in the DFM for the other ECL devices.

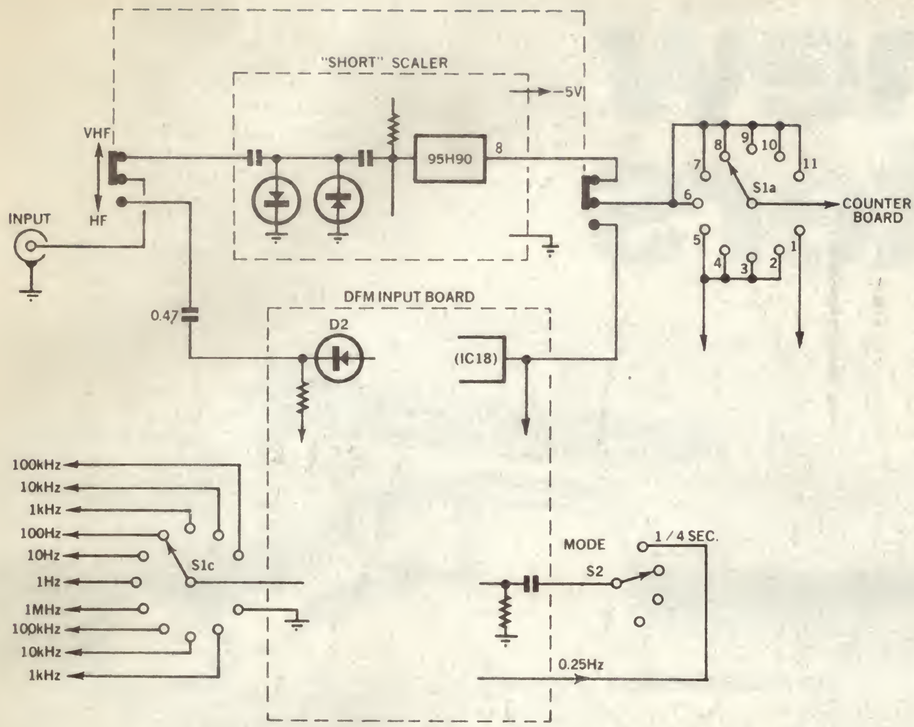
The lower input frequency limit for reliable operation of the 95H90 device with sinewave inputs is approximately 1MHz, so that it is really not suitable for use with all input signals. However, on the other hand, the existing input shaping circuitry of the DFM is not capable of working at VHF, so that it also cannot be used with all input signals. A switch must therefore be used to connect either into circuit alternatively between the DFM input connector and the gating circuitry. The switch may logically be marked "HF-VHF".

Note that the correct position of this switch will depend purely on the frequency of the input signal, and not on the range selected. Even when one switches down to lower ranges to look at the less significant digits of a VHF signal, it is still necessary to have the switch in the "VHF" position, as the input circuitry must still handle the fill signal frequency.

On the prototype instrument, rather than add a further switch to the front panel, I merely changed the connections to the switch used originally to select either AC or DC input coupling, so that this switch has become the "HF-VHF" switch. The DC input facility had never been used since the instrument had been built, so that it is no



The wiring diagram for the "long" version of the scaler. If the "short" version is required, the board may be cut through between the two etched notches, and wired as per the circuit.



How to convert the May 1970 DFM to count up to 200MHz. Few parts are needed.

great loss. The original coupling capacitor is simply wired permanently in series with the HF input circuitry, as shown in the small diagram.

Because the scaler involves a 10:1 input division instead of the 2:1 division used originally, the appropriate timebase frequencies for correct readings will now be 100kHz and its sub-multiples, not 50kHz and its sub-multiples. Happily these frequencies are already available on the timebase board, so that it is simply a matter of changing over the connections from the range switch wafer S1c to the timbase board. The new frequencies used are as follows:

Range (HF)	Timebase Frequency
0-1999Hz	1Hz
0-19.99kHz	10Hz
0-199.9kHz	100Hz
0-1.999MHz	1kHz
0-19.99MHz	10kHz
0-35MHz or more	100kHz

Strictly it would be necessary to divide these frequencies by ten when the input switch is in the VHF position, to compensate for the 10:1 division introduced by the scaler. However this would involve either a further wafer on the range switch, or another 10:1 frequency divider IC. Even then it would be necessary to add further provision to reduce the lower sampling rate, as for the lowest range the gating time would be no less than 10 seconds.

This additional complexity seems to me unwarranted, when one can easily perform a mental x10 multiplication whenever the scaler is switched into circuit. All one has to remember is that readings obtained with the input switch in the VHF position are one-tenth of their correct value; thus the lowest range really reads in units of 10Hz instead of 1Hz, for example, while the highest range reads directly in MHz and not in units of 100kHz.

Note that the original 2:1 input divider board also included a flip-flop used to divide the lower sampling rate to 0.125Hz. This rate was necessary to allow correct operation with the 0.5Hz timebase frequency used for the lowest frequency range. As the lowest timebase frequency will now be 1Hz, this low sampling rate is no longer required. The 0.25Hz output from the input board may now be taken directly to the sampling switch, giving a lower sampling rate of 1 every four seconds.

After the scaler is completed, there is only one adjustment required to ensure that it is operating correctly. This is exactly the same for either the "long" or "short" version: adjustment of bias for maximum input sensitivity.

The best way to make the adjustment is to feed a VHF signal into the scaler input, with its output connected either to a digital counter or to an oscilloscope. Then the bias preset pot on the scaler board is simply adjusted for reliable operation with the smallest possible input voltage. As viewed on a counter, this will be evident as the bias setting at which one can reduce the amplitude of the VHF input furthest before the reading starts to fall from its correct value and begin to vary randomly. On an oscilloscope, it will be the setting where the input can be reduced furthest before the output waveform begins to exhibit "drop-out". Its as simple as that!

YOU WILL NEED THESE COMPONENTS

- *1 Instrument case, as required.*
- *1 Printed wiring board, 4½ x 2¾ in, 72/s10.*
- *1 Stepdown transformer, secondary 12.6V CT at 1A.*
- *2 Coaxial connectors, panel mounting.*
- *1 Miniature SPST toggle switch, 240V rating.*
- *1 Ferrite bead, type FX1115 or similar*
- *1 6V 50mA pilot lamp bezel.*
- *1 150uH peaking inductor.*

SEMICONDUCTORS

- *1 95H90 or GHJ121 decade divider IC.*
- *1 9001 high speed flip flop 1C.*
- *1 7490 or 9390 or FJJ141 decade divider IC.*
- *1 2N4258 very high speed PNP silicon transistor.*
- *1 2N3565, BC108, or similar.*
- *2 EM401, BY126/50 silicon diodes.*
- *2 OA91 or similar germanium diodes.*
- *1 BZY88/C5V1 or similar 5.1V 400mW zener diode.*

RESISTORS

5% half watt: 1 x 68 ohm, 1 x 120 ohm, 1 x 220 ohm, 1 x 270 ohm, 1 x 470 ohm, 1 x 680 ohm, 1 x 2.2k.

- *1 12 ohm 1 watt.*
- *1 1k miniature tab pot.*

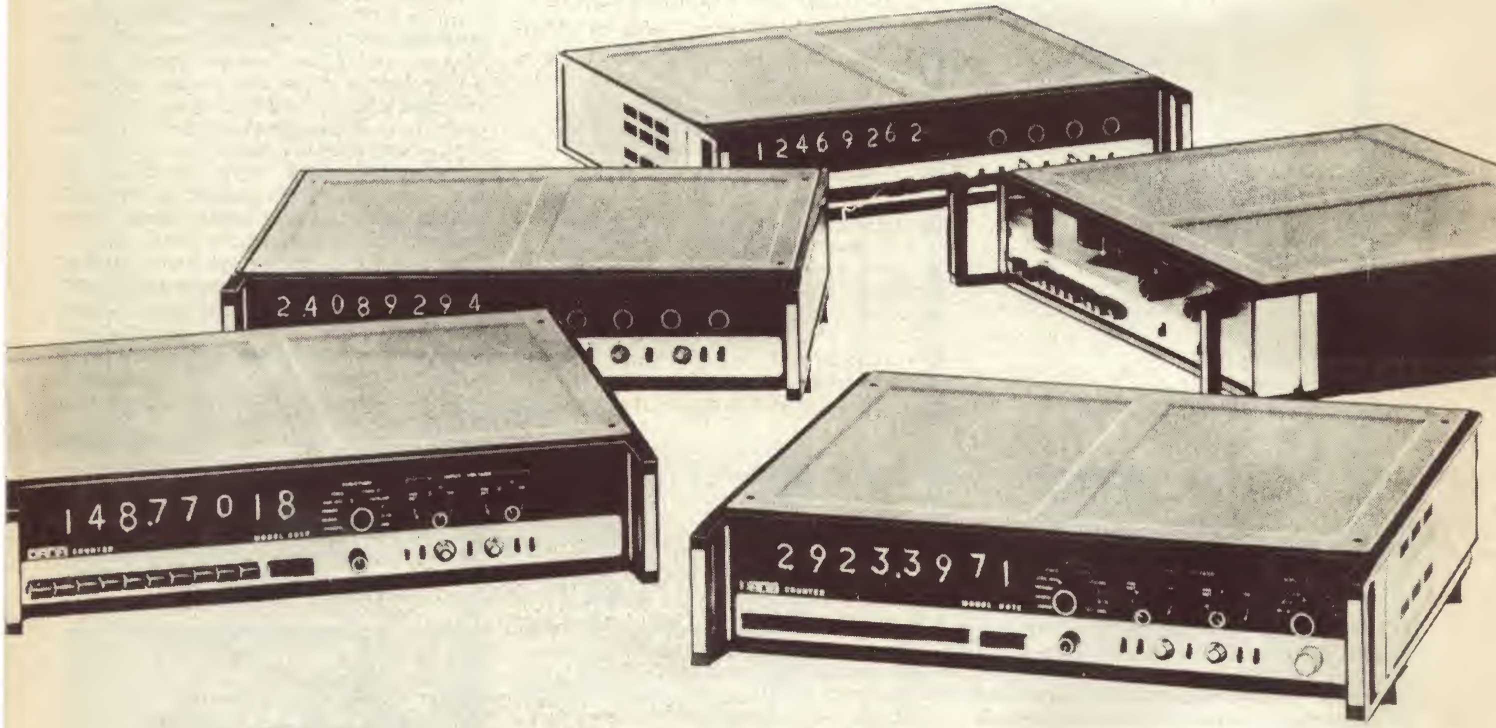
CAPACITORS

- *3 .01uF disc ceramic*
- *5 .022uF disc ceramic.*
- *2 1000uF 10 VW electrolytic*

MISCELLANEOUS

Mains cord and plug, clamp for cord, connecting wire, solder lugs, screws, nuts, etc.

five new counters



- **0-550 MHz**
- **4 MEASUREMENT MODES**

DANA®

8000B Series

For further information contact
Australian Representatives

JACOBY MITCHELL

SYDNEY ..... 630 7400 BRISBANE 44 4674
MELBOURNE 41 7551 ADELAIDE 93 6117
PERTH 28 5725

Digital Electronic Counters for versatility and reliability *without* multiple plug-ins.

Each counter in the series provides 4 measurement modes: Frequency, Period, Multiple Period Average and Totalise. An additional 4 modes are available on some models providing extended frequency range to 550 MHz, Time Interval, Time Interval Average and Frequency Ratio.

NO LONG WARM-UP DELAY. This is eliminated by use of a TCXO, which also achieves optimum versatility and accuracy in a general purpose counter. (A higher stability TCXO and a range of oven oscillators are options.)

INPUT SENSITIVITY. Normally 50 mV to 550 MHz while an optional amplifier will increase this to 1 mV with automatic triggering. This high sensitivity allows frequency measurements with up to 99% AM present on the signal.

Simple Logic Probe uses LEDs for readout

Easily built at low cost, this simple unit is ideal for troubleshooting in modern digital circuits using ICs. It uses a TTL device and two light-emitting diodes (LEDs), and is housed entirely within a transparent probe case. Build it to gain valuable experience!

by JAMIESON ROWE

Familiar test aids like the multimeter or VTVM are not much help for troubleshooting in or debugging digital circuitry, due to the on-off nature of digital signals. Until recently, this meant that one had almost no choice but to use an oscilloscope, and generally quite an elaborate one at that.

Happily the progress of digital technology has evolved a new type of test device, one appropriate to itself: the logic probe. Something like a pen-sized digital version of the old signal tracer, this new device provides a quick and convenient indication of the digital state-of-affairs at any point in the circuit.

Small wonder, then, that the logic probe is already widely used among those involved in either development or maintenance of digital equipment, and in fact is fast becoming as ubiquitous and indispensable as the slide rule.

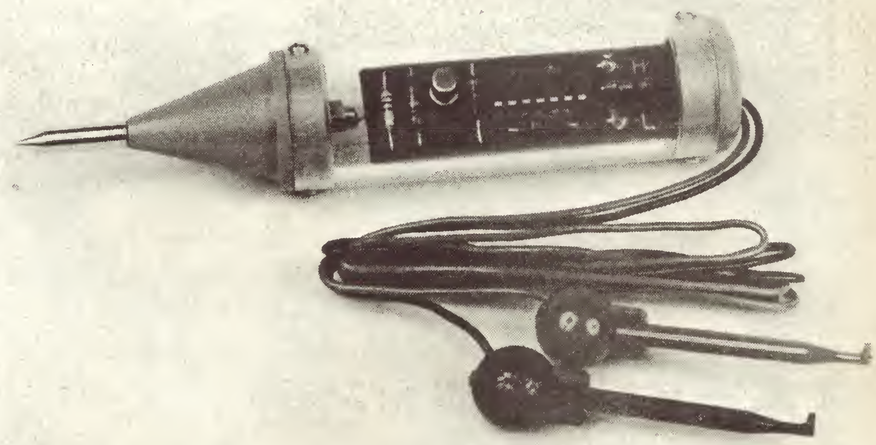
Commercially available logic probes tend to be rather elaborate devices, generally designed to perform such functions as detecting ultra-fast and narrow pulses, and indicating a wide variety of possible circuit malfunctions. Accordingly the price tends to be rather high, and this together with the fact that a somewhat simpler probe is still quite adequate for many situations has resulted in a spate of designs for simpler and cheaper probes.

The logic probe described in this article falls into the latter category; its main claim to fame is that it achieves what must surely be some sort of "ultimate" in terms of simplicity and low cost, using currently available components. It uses only one IC, a transistor, three resistors and two LEDs. An additional resistor and zener diode may be fitted if desired, to allow the probe to cope with a greater range of input voltage levels.

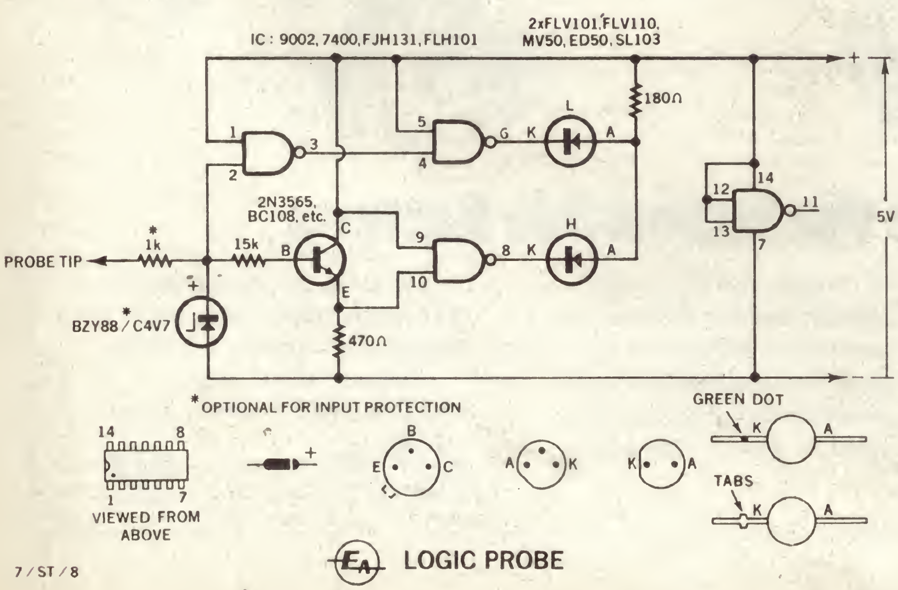
Yet despite its simplicity, the probe gives a clear and unambiguous indication of either circuit high voltage level (H), low voltage level (L), or an open circuit. It will also indicate if pulses are present, allow an estimate to be made of their duty cycle, and in the case of low-speed circuits also allow estimation of repetition rate.

Basically it has been designed for troubleshooting in modern TTL and DTL circuitry, but if the zener diode input protection is fitted, it may be used to test in circuits using higher voltage levels, such as MOS logic and older discrete bipolar logic.

The probe may be used with circuits having either supply polarity grounded, and with circuits having any logic convention, as its indication is purely in terms of voltage high (H = more positive level) and voltage low (L = more negative level).



Above is a view of the completed probe, fitted with input overload protection. The complete circuit is at lower left.



Power supply requirement of the probe itself is 5V DC, at between 10mA (idle current) and 35mA. This may be taken from the circuit under test in the case of TTL and DTL circuitry, simply by clipping a pair of leads from the probe to the circuit power bus lines. With higher voltage circuits a suitable source of 5V will have to be provided, with its negative polarity tied to the most negative circuit supply line.

The basic logic circuit of the probe is not original. I have taken it from a similar unit described in the August 1972 issue of the US amateur radio magazine "QST", by E. H. Rogers, KOGKB, and apparently developed at the Metrology Section of the National Bureau of Standards, in Boulder, Colorado.

The probe described by Rogers uses small incandescent lamps, and a hex inverter IC with two inverter elements paralleled to drive each lamp. I have replaced the in-


EVEREADY
TRADE MARK
ALKALINE
ENERGIZER
EXTRA
HEAVY DUTY
UNION
CARBIDE
MADE IN AUSTRALIA

candescent lamps with LEDs, which are not only more efficient but considerably more reliable. The use of the LEDs has also allowed me to avoid the necessity of paralleling TTL elements (a technique frowned upon by the makers), due to the lack of inrush current. Instead of a hex inverter device I have been able to use a quad NAND gate, which may be either a 7400, a 9002, or an FJH131.

Although different from the original probe in these respects, the new probe uses the original logic configuration. Although I tried a number of other possibilities, I came back to the original Rogers logic because it seems to be the simplest and most reliable way of achieving the desired result. In fact it is most ingenious in the way it uses only a handful of elements to indicate not only the H and L states, but also open circuits.

The "low" (L) indicator LED is driven by two cascaded gate elements, each connected as an inverter. When the probe tip is pulled down to the low level by a "low" in the circuit under test, the output of the first inverter is driven high, and in turn the output of the second inverter goes low. This pulls the LED cathode down, allowing the LED to draw approximately 20mA of current via the 180 ohm limiting resistor.

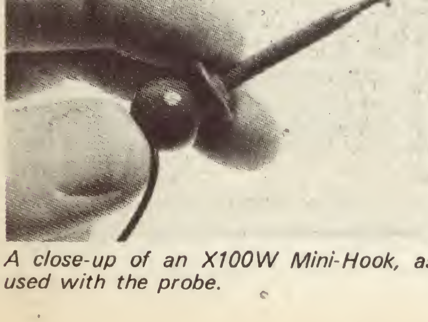
The "high" (H) indicator LED is driven by a single gate, again connected as an inverting element. However in this case the input of the inverter is not connected directly to the probe tip, but rather to the output of a simple emitter follower stage used as an input buffer.

It is actually the emitter follower which prevents the H indicator LED from operating in the event of the probe tip being connected to a point which is open circuit. Without the follower, the H indicator LED would glow for both high levels and open circuits, because a TTL gate input is inherently "high" until pulled low. The 470 ohm emitter resistor of the emitter follower effectively pulls the H inverter gate input down to "low" in the event of an open circuit, yet the follower still allows the gate input to be taken high by an H input.

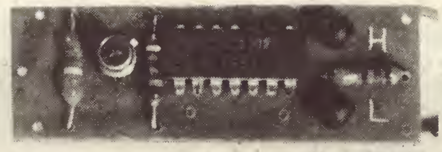
Note that the base current taken by the follower is quite small, so that in the open-circuit input condition insufficient current is drawn from the input of the first "low" inverter gate to lower its potential significantly.

By keeping both LEDs extinguished for the open-circuit input condition, the emitter follower thus allows the probe to indicate this condition unambiguously.

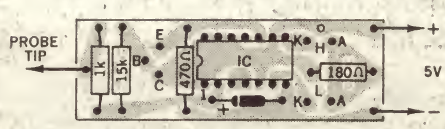
In the basic form thus described the probe is completely practical, and suitable for all TTL and DTL logic circuits operating from a nominal 5V supply. However the base-



A close-up of an X100W Mini-Hook, as used with the probe.



Above is the board wired for the basic probe circuit, shown actual size. Below is the wiring diagram for the full version.



PARTS LIST

- *1 Printed board, code 72/10, 0.7 x 2.25in.*
- *1 Probe case, 3in, with transparent barrel (Jabel type PH3T).*
- *1 Quad 2-input TTL gate IC, 7400 or similar.*
- *1 2N3565, BC108, or similar.*
- *2 Light-emitting diodes (see text).*
- *2 Test clips (E-Z-Hook type X-100W), one black, one red.*
- *1 180 ohm ¼ watt resistor.*
- *1 470 ohm ¼ watt resistor.*
- *1 15k ¼ watt resistor.*
- *1 1k ¼ watt resistor (optional)*
- *1 BZY88/C4V7 or similar 4.7V/400mW zener (optional).*

emitter junction of the input transistor of the first "low" inverter gate would be damaged if the probe input were connected to a voltage higher than about 5.6V with respect to the negative supply line.

To enable the probe to be used for checking operation in circuits using higher voltage levels, it is therefore necessary to protect it from damage. This is simply achieved by the addition of a clipper circuit using a series 1k resistor and a low cost 4.7V / 400mW zener diode.

The complete probe circuit is mounted on a very small printed wiring board — it measures only 0.7 x 2.25in (18.5 x 156mm). The pattern for the board is coded 72/i10. Sample boards for the prototype probes were kindly supplied at short notice by RCS Radio Pty Ltd, but other manufacturers have been sent the pattern also, and should be able to supply boards shortly.

The IC used in the probe is a standard low cost TTL quad NAND gate. Suitable devices which may be used are the 7400, the 9002 (Fairchild), the FJH131 (Philips Elcoma), and the FLH101 (Siemens). These are all pin-for-pin equivalents.

As with the IC there are many possible low cost LEDs which may be used. In fact you can use almost any type of visible-output LED which will fit into the board physically. Suitable types are the FLV101 and FLV110 (Fairchild), MV50 (Monsanto, from Hawker Siddeley Electronics), ED50 (European Electronic Products, from General Electronic Services), SL103 (Plessey Imported Components) and 5082-4403 (Hewlett-Packard).

The transistor used in the emitter follower may be any general-purpose NPN silicon type with a beta of around 100 or more. The usual choice would be a 2N3565 or a BC108, etc, but almost any NPN silicon device could be pressed into service.

The resistors used should preferably be quarter-watt types as these will fit more conveniently into the spaces available on the wiring board. However the more readily available half-watt types may be used if the smaller resistors are found hard to obtain.

The wiring board of the probe fits snugly inside a probe case made of transparent acrylic. The probe case is a new addition to the well known "Jabel" range, distributed by Watkin Wynne Pty Ltd, and has in fact been designed by this firm especially for the project. Designated the PH3T, it is very similar in appearance to the other Jabel probes apart from the clear barrel. Watkin Wynne very kindly made samples of the new probe case available to us at short notice for use in the prototypes.

It is desirable to fit the power supply leads of the probe with some sort of quick-connect clips so that they may be easily and rapidly hooked onto the 5V supply lines of the circuit being tested, and then just as easily removed when testing is completed. While casting around for suitable clips for the prototype units, our attention was drawn to the "E-Z-Hook" range of clips, made by Tektest Incorporated in the USA. The Australian agents for these products are General Electronic Services Pty Ltd, of 114 Alexander Street, Crows Nest 2065.

We finally settled on the type X100W Mini-Hook from the E-Z-Hook range, and these are visible in the photographs. They are available in red and black for polarity marking, and feature a very small spring-loaded hook connector which provides a very convenient and effective means of connecting to small component leads.

When you have completed the probe, using it is simplicity itself. The first step is to clip the two power supply leads to the 5V supply lines of the circuit to be tested, making sure that correct polarity is observed. Then it is simply a matter of touching the probe tip to each point of interest in the circuit, and observing which of the two LEDs glows — if either.

If the H LED glows, the point concerned is at the high level, while if the L LED glows the point is at the low level — or conceivably it could be shorted to the negative line. If niether LED glows, the point is open circuit.

If pulses are present, both LEDs will tend to glow, either alternately in the case of long slow pulses, or with apparent continuity in the case of short pulses with a high repetition rate. In the latter case the relative brightness ratio of the two LEDs will allow a reasonable estimate to be made of the pulse duty cycle or "mark-space" ratio.

Electronic Reverberation

by ALAN M. FOWLER, MIE Aust., MIREE

The second of two articles explaining the operation of electronic reverberation systems. In this article the author deals with digital and analog shift register techniques using integrated circuits.

Alan Fowler is Principal Engineer in the Lines and Data Systems Section of the Australian Post Office. His areas of interest are design and application of digital logic, analog to digital and digital to analog conversion, delta and pulse code modulation, and particularly the design of digital test equipment.
Since submitting this article for publication, Mr Fowler has won the IREE Bronze Medallion for 1971 for the most meritorious paper published in the IREE "Proceedings" during that year (see "News Highlights" section of this issue of E-A).

There are currently three basic methods that can be used to provide an all electronic delay line. The first makes use of one of the properties of a filter that an electric signal takes a definite time to propagate through it. By using a filter made up of many elements, it is possible to obtain delays of the order of milliseconds over a reasonable audio bandwidth. The filter may be built from a series of L-C sections, or from a number of active sections which need no inductors. It has been said that this approach is prohibitively bulky and expensive, but modern materials and techniques have changed this, and one manufacturer uses this technique to produce a compact unit having a delay of 10ms over the audio band to 5kHz.

In the second method, the signal is first changed into digital form, the digital signals delayed by passing them through a series of shift registers, and the output of the shift register then converted back into an analog signal which is a delayed version of the input wave form.

Either pulse code modulation (PCM) or delta modulation may be used to convert the input signal into the digital form. In PCM, a brief sample is taken of the input signal at regular intervals, and then stored while the amplitude and sign of the sample is measured using a simple digital voltmeter called an encoder as illustrated in Fig 6.

The output from the encoder is a series of pulses which make up a code group representing the voltage of the sample, and usually consist of a sign pulse, and a series of pulses or absence of pulses representing the "ones" and "zeros" respectively of the binary value of the sample.

The successive groups of pulses can be combined into a single pulse stream having a uniform repetition rate, or clock rate, which will be an integral multiple of the sampling rate, and which will depend on the number of digits used in the code group. The pulse stream may be read into a chain of storage elements, so arranged that as each "1" or "0" is read in, the previous contents of that storage element is transferred into the next one in the chain.

These chains are called shift registers, and the information is shifted progressively through them under the control of the clock pulses. The information will be available at the end of the shift register after a delay of exactly "n" clock periods, where "n" is the number of stages in the shift register. Bipolar shift registers are limited to about eight or sixteen stages, but MOS devices are now readily available with 512, 1024 or 2048 stages in a single T099 or Dual-in-Line (DIL) package, so that reasonably long delays can be provided with a small number of packages.

At the output of the shift register, a digital-to-analog (D-A) converter generates a series of voltage pulses whose heights are determined by the received code groups. The pulses are passed through a low pass filter having a cut-off frequency slightly above the highest required frequencies in the input signal, to recover the original waveform. Fig 6(b) shows the "square" pulses out of the D-A converter, and the analog signal obtained after low pass filtering. Compare this output waveform with that of the input signal in (a).

The input waveform must be sampled at least twice as fast as the maximum frequency to be transmitted, and for a bandwidth of 200 Hz to 4kHz, the sampling rate will be typically 10,000 times per second. If the code group consists of 10 binary digits or "bits", ie the analog amplitude range has been divided into a total of 512 (— 2^9) positive and 512 negative levels, the clock rate will be 100kHz and a single 1024 stage package will provide a delay of 10.24 ms.

Further packages can be added to increase the delay to the desired value, and shift registers containing a smaller number of stages can be used where shorter delays or finer tappings are required. Where there is more than one tapping, separate D-A converters may be used for each tap and the outputs combined in a common amplifier. The D-A converters are relatively expensive and if many taps are required it would be more economical to add the signals digitally and then use a single D-A converter. For this application the analog signals should be represented by a binary code.

A simple digital adder can be built from three type 7483 integrated circuits which will add together two 10 bit binary numbers (including the sign) in less than 80ns. The signal levels can be adjusted by multiplying the digital output from each tap by a binary number less than one, using repeated shifting and addition. (Appendix 1). Using the previous example, with a sampling rate of 10,000 per second, a period of 100us is available between samples to carry out the necessary additions. Only a single adder stage is required, and this can be time shared for the multiplication and addition of the outputs from the various taps.

A shorter shift register can be used by feeding part of the output back into the input (Fig. 5). The feedback can be in analog form by taking the output from the D-A converter, or in digital form in which case an adder and control unit can be used as above. A smoother frequency response may be obtained by taking the outputs from several tappings, combining these, and feeding the combined signal back into the input.

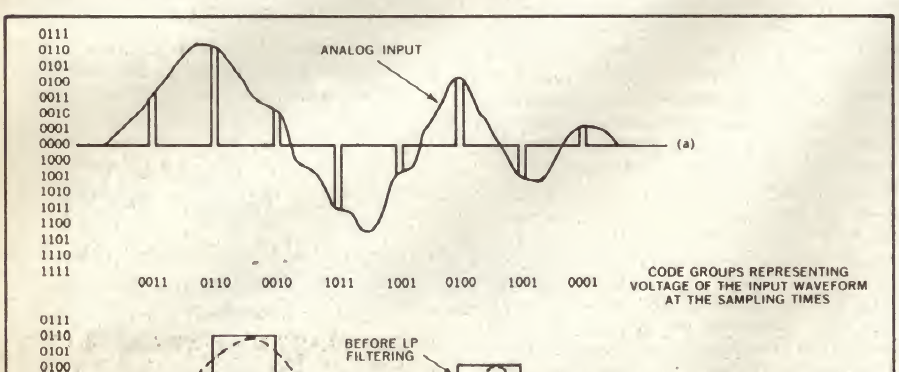


Fig 6. Digital transmission using code modulation; (a) input signal with samples, (b) decoded output before and after passing through a low pass filter.

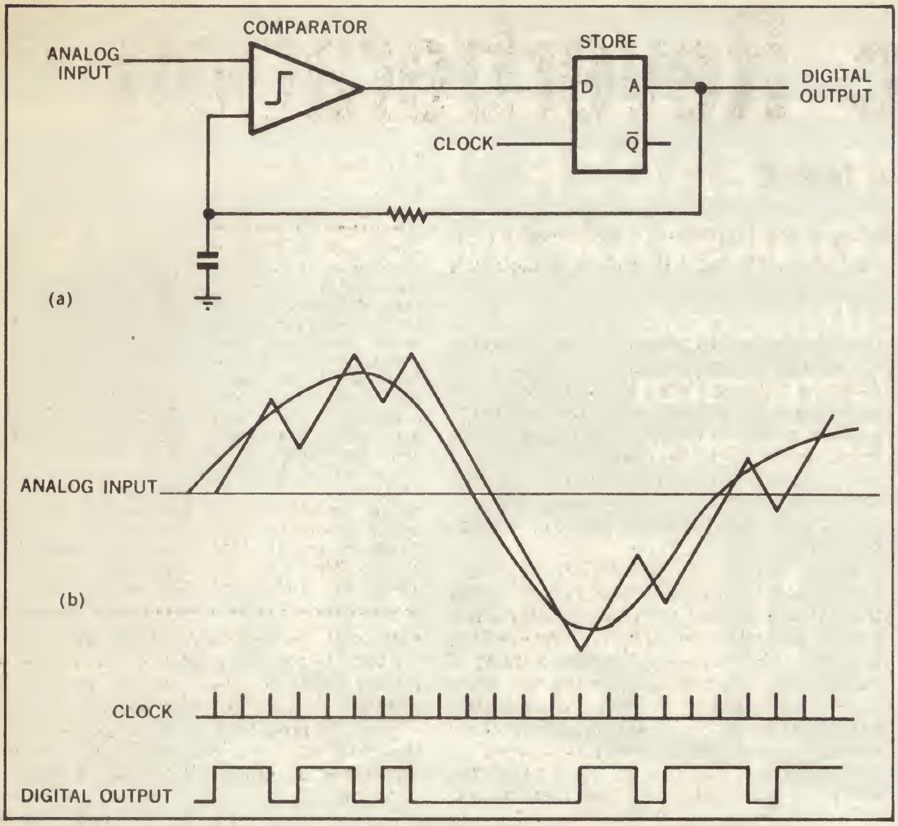


Fig 7. Digital transmission using delta modulation; (a) simple modulator, (b) waveforms.

An alternative digital approach is to use a delta-modulation encoder to generate the digital stream. The simple delta coder shown in Fig 7(a) uses a feedback loop to generate a voltage which tries to track the input waveform (Fig 7(b)). The comparator continuously compares the input signal with the feedback signal and its output goes high or low depending on which of the signals is more positive. This information is transferred to the store each clock period and is fed out to line as a series of ones or zeros. This same string of pulses is fed into the R-C network, and while a "one" is being transmitted the resistor will be connected to the positive supply and the capacitor will charge.

During a zero, the resistor will be connected to earth, and the capacitor will discharge. The time constant of R-C is made very long — about 100ms or more, so that it takes a long string of ones or zeros to fully charge or discharge the capacitor. With no input the coder will transmit alternate ones and zeros, and the capacitor will charge up to half the supply voltage.

With a simple encoder such as this, the signal can be reconverted to the analog form by using a single R-C network. Where a number of delays are required, the taps from the shift register can feed separate R-C networks, and the outputs of these combined. For some applications it may be convenient to use a single capacitor with a resistor to each tapping point on the shift register. The level of each echo can be adjusted by varying the value of the appropriate resistor.

Both the PCM and the delta-modulation system are capable of very good performance, but both introduce a new type of distortion, called quantizing distortion. The PCM encoder divides the total signal range up into a number of discrete levels. In Fig 6(a) there are a total of sixteen levels, eight positive and eight negative. A signal having any value between two successive levels will be represented by the lower of the two levels, and for a number of successive samples the output of the decoder will be a series of steps instead of a continuous wave.

For signals having a value in between the quantizing levels the output will be in error by an amount of up to the difference between successive levels. This error voltage is nearly random in nature, and sounds very much like noise. It is, however, a distortion, as its mean level is related to the signal level, and it is not present when there is no signal. The error can be made very small, by using a large number of ranges — and by decoding in such a way that the maximum error can only be plus or minus half the difference between successive levels.

For an encoder having 1024 levels (total) the error at the top of the range will produce a distortion of 0.1%. This will rise at low levels, until on the lowest step in the range it will be 50%. The total range of levels which may be represented is 54dB ($= 20 \log_{10} 512$) and at mid range (27dB) the distortion will be about 4.5%. The distortion, and dynamic range can be improved by increasing the number of levels. For instance with $2^{14} =$ 16,384 levels, the above figures would be divided by a factor of 16. The penalty here is that the shift registers must be increased in length and more complicated and expensive encoders and decoders are required.

Delta modulation also suffers from quantizing distortion due to the error voltage between the original signal, and the feedback signal which is trying to track it. There is a further form of distortion that

LEADER TEST INSTRUMENTS

LBO-311 3" OSCILLOSCOPE

This 75mm (3") oscilloscope meets the requirements for a low cost general purpose instrument for waveform observation up to 1mHz without sacrificing the sensitivity. It has an effective display area of 8x10 div. (1 div. = 6mm).

Recommended for use where elaborate oscilloscopes are not necessary, as in service shops, ham stations and educational institutions.

LAG-26 AUDIO GENERATOR

LAG-26 is a stable generator for testing all types of audio circuits from simple devices to hi-fi amplifiers. Operating controls are functionally laid out for ease in handling. This instrument is well adapted for all round use in servicing and instructional purposes.

AVAILABLE FROM ALL LEADING & ELECTRICAL SUPPLY HOUSES.

LSG-16 SIGNAL GENERATOR

Here is a compact solid state RF signal generator designed for the hobbyist, service bench and technical instruction. The generator is an updated version of the well known LSG-11 signal generator. It is designed specifically for checking and aligning IF circuits and tuners in AM, FM radios and TV sets. The circular calibrated frequency scales insure high accuracy in setting and readout.

FOR MORE INFORMATION CONTACT:

WF WARBURTON FRANKI

- ADELAIDE 56-7333
- BRISBANE 52-7255
- HOBART 23-1841
- MELBOURNE 69-0151
- PERTH 61-8688
- SYDNEY 648-1711

WF2.0491

occurs when the analog signal rises or falls at a rate too fast for the feedback signal to track. This generates large error signals and is known as slope overload distortion. Again, the effect of both of these can be reduced by using a higher clock frequency and the penalty is again the need to provide longer shift registers to handle the greater number of bits for the same delay.

Simple delta modulation encoders such as this have a limited dynamic range. The threshold level or the minimum signal which may be transmitted is constant at all frequencies over the band, but the maximum amplitude which may be transmitted falls at 6dB per octave due to slope overload. For a sine wave signal, the maximum slope occurs at the zero crossings. As the frequency is increased, the amplitude must be reduced to keep this slope constant. For the simple coder described, the range between maximum and minimum signal will be about 30dB at 1kHz for a 100kHz clock frequency.

The performance of both the PCM and delta modulation systems can be improved by some form of companding — i.e. compression of the analog signal before or during encoding, with a corresponding expansion during the decoding process. In PCM the output of a linear coder having 2^{12} = 4096 levels may be compressed to eight bits per sample, i.e., a reduction of one third in the number of shift register stages required, without seriously degrading the performance.

Both forms of digital system suffer from the effects of quantizing the analog signal into a number of discrete levels. An alternative approach is to sample the signal at regular intervals, but keep the samples in analog form and pass them consecutively along an analog shift register.

An analog shift register may be made from a series of sample and hold circuits as shown in Fig 8. The odd numbered stages are driven directly from the square wave clock, and the even numbered stages from the clock through an inverter. While the clock is high the voltage on each of the even numbered capacitors remains constant, while the odd numbered ones are charged (or discharged) to the voltage on the preceding one. While the clock is low the voltage on the odd numbered stages remains constant, while the even numbered ones are charged to the new value.

The chain therefore acts as a series of master-slave stages, and by analogy with the old fire fighting method where the buckets of water were passed from hand-to-hand along a chain, is sometimes called a "bucket-brigade delay line".[4] F.J.L. Sangster[5] of the Philips Research Laboratories in Eindhoven, Holland, has recently developed such a delay line in integrated circuit form.

Sangster has developed a simple but elegant solution which only needs a single transistor and capacitor for each half stage. In the circuit in Fig 9(a), the transistors are all identical, and all the capacitors have the same value. The operation starts with all capacitors charged to voltage V, except Cin which is charged to Vs1, the value of the first sample. At time t1 the base of TR1 is raised to voltage V by the clock, and this

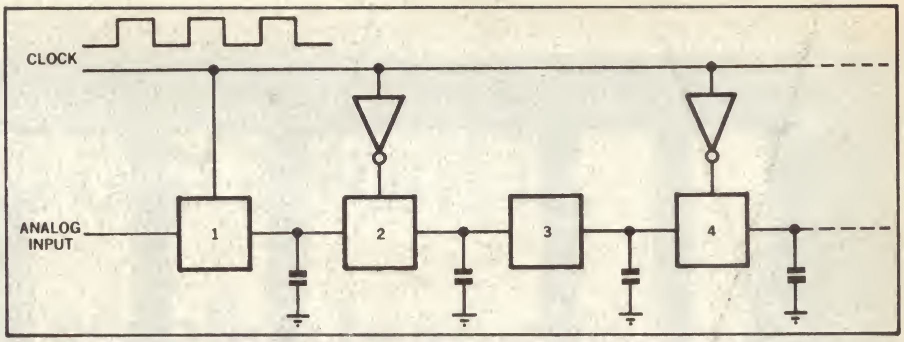


Fig 8. Analog shift register built from a series of sample and hold stages.

will add to the voltage across C1 raising the collector of TR1 2V volts above earth. Cin will charge to V volts, and as the base-emitter junction of TR2 is reversed biased, and we assume that TR1 has a very high β, the current to charge Cin must come from C1.

The net results will be that C1 will be discharged to Vs1. At time t2 clock 1 drops to zero volts and clock 2 goes to V volts, C1 will be charged to V volts and C2 discharged to Vs1. At the same time we arrange for Cin to be discharged to the next sample Vs2. In successive clock periods, the samples will propagate down the line to the right, which is the desired result. The input voltage must always be positive, so that a suitable DC bias must be added to the input signal.

There are several minor problems in this approach, firstly the capacitors do not charge to the full value V of the clock voltage, but to a value of about 400 to 600mV less due to the forward drop across the base-emitter junctions. Secondly, the base-emitter current, although small, cannot be ignored, and the effect of both of these is to cause a small loss of signal in each stage and this loss becomes greater at higher frequencies. The loss can be overcome by including an amplifier stage at regular intervals, but the high frequency loss sets an upper limit to the operation of the system.

One of the advantages of Sangster's approach is that the capacitors need not all be exactly equal in value. What is really transferred between stages is a charge, not a voltage, and as the charge is related to the product of the voltage and the capacitance, it is only necessary for the input and output capacitors to be the same value for an overall unity gain. The capacitors need only be very small, a few pF is sufficient, and these may be easily included in the integrated circuit.

A shift register built to this design will

Electronic reverberation

operate at clock rates up to 30 MHz, so that it may be used to transmit signals up to 15MHz and is very useful as a variable delay line in TV applications. The lowest clock rate at which it can work is limited by leakage currents in the transistors to a few tens of kHz.

A similar design has been built using MOS techniques, which overcomes the problems of the base-emitter current in the transistors. The MOS version has a lower maximum clock rate, and can be used over a range of 100Hz to 3MHz. It can handle higher voltages than the bipolar version, and is particularly suited to audio applications.

All of the techniques described, both mechanical and electronic, have some shortcomings, and no one approach will be best for all applications. The most suitable method will depend on whether reverberation or separate echoes are required, and the minimum bandwidth, distortion and signal to noise ratio which may be tolerated, together with the cost of providing the system.

APPENDIX

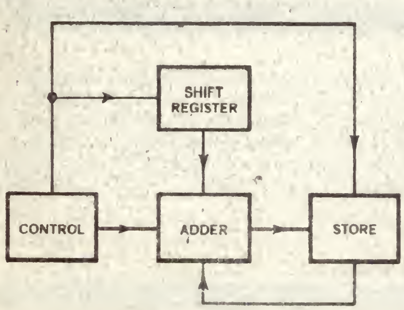
Binary Multiplication

To multiply 1010 (—10)
by 0.1011 (— 11/16)

```
 1010
   0.01011
 ---------
  101.0
   00.00
    1.010
    0.1010
 ---------
  110.111
```

∴ 1010 x 0.1011 = 6⅞

Store the value 1010 in the shift register, and the multiplier 0.1011 in the control, clear the store (set to 0). Taking the multiplier one digit at a time, (a) Add the value of the Multiplicand to the present value in the store, and store, if the digit is a one, or (b) do nothing if a zero, then move the contents of the shift register one place to the right. Continue the adding and shifting till all digits have been used.



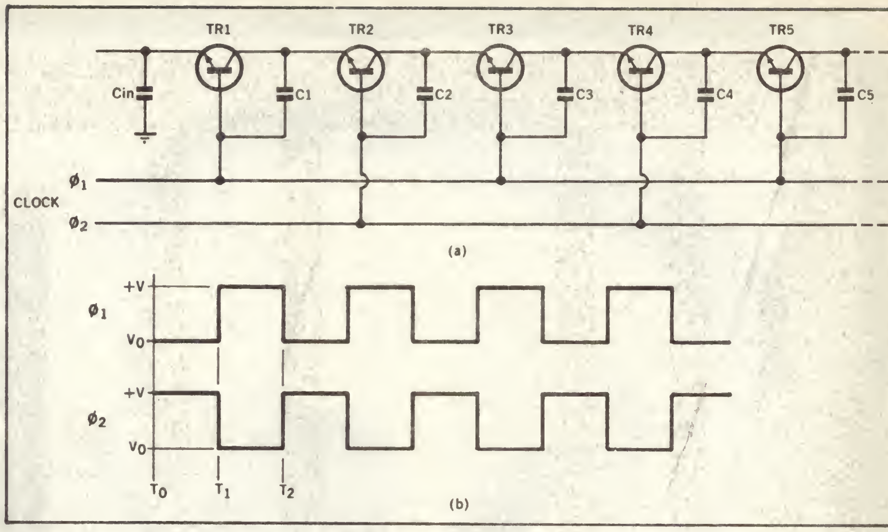


Fig 9. (a) "Bucket Brigade" analog delay line; (b) clock waveforms and timing.

Earlier in these articles it was shown that to provide a complete simulation of the reverberation characteristics of a particular room, it was necessary to use a separate reverberation generator for each frequency band. This approach would only be necessary for very accurate work, and for many purposes an adequate reverberation effect may be obtained by assuming that the reverberation time is constant over the band from say 200Hz to 4.5kHz and drops to zero at other frequencies, so that only a single reverberation channel is required.

For home use, the spring type units are the cheapest, ranging from $5 to $20 for the unit, and need little auxiliary equipment. The acoustic line approach would also be in the same order of cost, and both are capable of good results if only reverberation is required. The tape recorder is capable of excellent results and the costs will range from $100 for a simple machine with a fixed delay to $5000 or more for a machine with several adjustable heads and wow and flutter performance suitable for professional applications.

The costs of integrated circuits are still falling, and digital shift registers can be bought for 1 to 2 cents per stage, so that a delay unit using a 250kHz clock rate will cost between $2.50 and $5.00 per millisecond. There are now commercially available A — D and D — A converters using a 10 bit code, and which operate at 25,000 samples per second. A pair of these plus a suitable sample and hold unit costs about $200. A delta modulation system having a similar performance will be about the same order of cost.

One of the most promising approaches to date is Philips' M31 analog shift register. Amperex Electronic Corporation recently announced the development of the M31, a thirty-two stage analog shift register which they expected would sell in the USA for less than $10 each. Although described as a thirty-two stage register, two stages are required for each master-slave pair and each M31 introduces sixteen clock periods delay. It is understood that these integrated circuits are made by Philips of Eindoven and only a few laboratory made prototypes have been available so far for evaluation.

At this stage there is no guarantee that the M31 will go into commercial production. Based on the Amperex expected price of $10 per unit, and using a clock rate of 10kHz, the cost will be almost $6 per millisecond of delays for a signal bandwidth of 4kHz. The method is so promising that it is likely that the M31 or an integrated circuit based on it will become readily available in the next year or so, and it could be expected that the price will drop as the demand rises.

With present day costs, the use of the all electronic system is likely to be restricted to the recording studio, and the serious amateur. It has been predicted that the costs of shift registers and other forms of memory will fall by a factor of ten by 1975, and therefore it is more than likely that suitable electronic reverberation equipment will become readily available at a reasonable price in the next few years.

The permission of the Senior Assistant Director-General, Australian Post Office Research Laboratories, to publish this article is hereby acknowledged.

REFERENCES

4. J. M. L. Janssen, Discontinuous Low Frequency Delay Line with Continuous Variable Delay," Nature, 169, 1952, pp. 148-149..
5. F. L. J. Sangster, "The Bucket Brigade Delay Line — A Shift Register for Analogue Signals," Philips Technical Review, Vol 31, N0 4, 1970, pp 97-110.
6. Electronic Design Vol 19, N0 24, Nov 25, P 34.

FORUM

Conducted by Neville Williams

Projects, copyright, patents and all that ....

What rights are vested in the ideas, articles and projects published in "Electronics Australia"? Do we seek to restrict readers who may wish to manufacture a project for commercial sale? What patent obligations are they likely to come up against and how are such obligations best met?

Questions such as those set out above are put to us from time to time by readers who are struck by the market potential of certain items described in the magazine. What follows is just such a letter recently to hand. We have deleted any hint of the address or the item the writer has in mind, so as not to prejudice action that he may care to take:

Dear Sir,

I have been a reader of E.A. and an electronics hobbyist for many years. Shortly, I will be going into business for myself manufacturing ——. As a sideline and a kind of "labour of love" I have been considering building useful electronics gadgets for resale on a small scale. Your —— would be a good example of what I have in mind.

Obviously, the problem would be how to know whether the units I would like to produce are covered by patents. Also, if the unit was developed in your laboratory, would you object to my reproducing it for sale? I was wondering whether, when I select a unit, you could tell me through the Query Service whether it embodies a patent or not?

Alternatively you may be able to indicate the existence of patents in the descriptive article.

Yours Faithfully, B.D.

That part of the problem which involves "Electronics Australia" directly can be disposed of in a fairly straightforward manner.

The prime role of our journal, as we see it, is to collect, generate and disseminate information; we have no other commercial involvement in the products and projects mentioned in our pages. If readers want to make use of our circuit designs, they are free to do so, in whole or in part, for hobby purposes or for commercial exploitation.

In fact, through the years, many suppliers have advertised ready-built Electronics Australia projects in these pages, ranging from television receivers to hifi amplifiers.

The one restriction we have put on these activities is a requirement that, where our name or project title is used, the kit or built-up project must conform to the original design. The substitution of equivalent components is permitted but not components which would prejudice performance or modify specifications.

If a supplier wants to market a kit or an item developed from one of our projects but differing substantially therefrom, they are free to do so — provided they do not identify it as an Electronics Australia project. They must assume full responsibility, credit or blame for the revised presentation.

However, while we do not seek to enforce copyright on designs in the electronic sense, we do reserve all rights to the actual published material — the article, the diagrams and the pictures. These should not be reproduced in whole or in part except by written arrangement with the Editor-in-chief or other authorised representative of the publisher. This is normal magazine practice.

Now for the really tough area — that to do with patents.

In the early days of receiver manufacture in Australia, there were endless wrangles about patent rights and ownership — wrangles that, in the ultimate, would have benefited the legal fraternity more than the contestants.

To avoid this situation, the major manufacturers became subscribers to a patents pool which oldtimers will remember as "ARTS & P" — the Australian Radio Technical Services and Patents Co. The broad arrangement was that participating companies pooled their patents and agreed on a surcharge to be made on all receivers manufactured in Australia. It was imposed in the form of a label which was purchased and affixed to each chassis — rather like the registration label on your car.

Participating companies split up the proceeds from the sale of labels in proportion to the number of patents each had in the pool. The more patents a company could tip in, the greater proportion it would get back of its own money and the other fellow's.

Most of the patents covering the manufacture of broadcast band receivers have now lapsed so that, for all practical purposes, broadcast receivers are royalty-free. However, the Australian patents pool still operates in respect to monochrome television receivers and obligations are currently being worked out in relation to colour receivers.

An individual who builds a television receiver for day-to-day use, as distinct from research, possibly has an obligation to the patents pool. If the receiver is sold or a receiver is made up for sale, the obligation would be strengthened.

In fact, the patents pool has not concerned itself overmuch with the activities of individuals making up the odd receiver, mainly because the cost of enforcement and collection would exceed the reward. So, by default, private TV set builders have enjoyed an "open go".

While the patents pool has served a very useful purpose, its functions have been related mainly to broadcast and television receivers. A company or individual planning to manufacture other electronics items for resale are "on their own". They have to discover for themselves possible patent obligations and act accordingly.

Let's say that you were grabbed by the idea of marketing an electronic whistle along the lines of the unit described elsewhere in this issue. We've done the basic development on the circuit; you've dreamed up a physical format which should appeal to the market you have in mind; as a marketing proposition it looks promising.

But is it subject to patents?

Unfortunately, there is no place where you can obtain an easy answer to this question, and no pool where you can obtain absolution from possible liabilities by the payment of a flat royalty. It has to be resolved the hard way.

You can, of course, put your problem to a patent attorney. He will arrange for a search of the relevant patents and will come up with an opinion which will not necessarily be beyond challenge.

We asked a patents expert how much this might cost. His answer: "It depends but it could be reckoned in hundreds of dollars".

If this prospect dismays, an individual can make a private search. It involves a visit to the patents office in a capital city, hopefully enlisting the assistance of someone in attendance to find out where to begin. You then carry on alone.

We asked our patents consultant how long this would take. His answer: "It depends, but let's say, two or three days!"

If it should happen that someone else has

Dear Sir,

In March 1970, I wrote to you on behalf of the Lions Club of Mitcham, seeking your permission to tape record the content of your Basic Radio Course publication for the benefit of a blind person in our community who was interested in gaining his Amateur Radio licence. That letter, and a follow up letter from one of the "hams" who recorded the material and instructed him personally, indicating that he had gained his restricted licence were published in the December 1970 edition of Electronics Australia.

It is with great pleasure that I report that he has recently passed his Morse exam, and has a full licence. His call sign is VK5ZN. I speak for every member of my club in expressing grateful thanks to you for giving us the key to this project, which has culminated in his success.

I cannot speak too highly of the dedication of the "hams" who have devoted many hours of their time in tape recording, personal tuition, and devising means of Morse training, and who are still helping him by constructing a transmitter to put him on the short-wave bands.

Yours sincerely,

J. R. Evans,

Immediate Past President, Lions Club of Mitcham.

a similar product on the market, it may be worthwhile to get hold of one and examine it carefully for patent notices. They will provide a starting point; the notices may be significant or they may be irrevelant — displayed mainly to impress buyers and discourage competitors! You would have to find this out.

What if the would-be manufacturer is short of both dollars and days, as might be the case with anyone starting out in a small way on a part-time basis?

To quote our consultant again: "He could look at the design and decide that it was a combination of old and widely used circuitry; on this basis he might decide to take the risk."

But what if he wasn't too sure about the circuitry? Wasn't prepared to assume that it would be virtually free of patent involvements?

Consultant: "Well, he could put aside 5 per cent of his selling price as an emergency fund, in case somebody did sue for royalties."

Question: "Is 5 per cent a realistic figure or did you just pluck it out of the air?"

Consultant: "Yes, it is a realistic figure. I could nominate a large electronic firm which does just this when it is not able to resolve a patent situation for one reason or another."

Question: Surely this uncertainty must discourage a lot of people who might otherwise venture into small-scale manufacture?

Consultant: "Yes, it's a fiendish situation, really."

Fiendish? Well, exasperating, anyway! And, having said all this, we've left our correspondent B.D. right where he was — still facing the need to make up his own mind.

Our advice could only be in the broadest terms:

- If a project relates to a commonplace piece of equipment, using common, basic circuits, the chances of it attracting royalty obligations are minimal.
- If a project uses an approach which is quite new and which has not been applied commercially, it may also be fairly safe to use. Publication may well have forestalled patent action.
- If a project shows how to duplicate or simulate an item which is strongly identified with one firm, or which is manufactured by others "under licence", have a care. Such a firm could be both jealous and zealous about its patent rights.
- Occasionally companies will seek to maintain exclusivity, even after patent rights have lapsed. In this case you may be able to compete freely, provided you do not infringe the original brand name, which may still be protected.

I make these observations with a good deal of trepidation because, in such matters, rules of thumb can be as dangerous as they are helpful. If you want to shoot them to pieces, don't hesitate to do so. The main thing is to exchange experiences in the hope that such exchange will shed light on what is a very blurry situation.

One final point: Why don't we define the patent situation relative to each project at the time of publication? Well, because the search would impose an intolerable burden for the sake of a few isolated readers. In any case it would still be only an opinion.

As we remarked at the outset, our role is to collect, generate and disseminate information about electronic doings and devices. We have to make the best use of the resources to hand in an effort to meet the majority needs of our readers.

The job of resolving patent obligations is really part of an entirely different operation — that of manufacturing and marketing apparatus. The person who ventures into that field must make his own decisions, as often based on odds as on proven facts!

ELECTRONICS ON THE FARM

Dear Sir,

I've been composing this letter in my mind ever since I read the article in EA some months ago about the construction of a party game involving an electric shock from a chair.

As I am burning the midnight oil I might burn a little bit more and set out my thoughts. If it is possible for the Electronics Australia design staff to think up a simple device like that for fun, I wonder what they could do in the way of some simple electronic devices to help on the farm?

You might think that this is a rather outlandish request to make. But it is just possible that some of your readers have developed time-saving electronic farm aids. On the other hand, the magazine might be able to get to work on some.

The devices would need to be capable of being built from parts available by mail order.

In the weather field there are all sorts of recordings to be taken, maximum and minimum temperatures, humidity and so on. Any help here?

As you can see from my address I have a vineyard. I would be interested in a frost warning system, an electronic bird scare, a tensiometer or neutron meter for reading soil moisture, so that I will know when the vines need water.

Is there a simple, robust, dust-free shakeproof broadcast receiver which could be used to break the monotony of those hours on the tractor?

If you think that electronics and agriculture don't mix I will pull my head in straight away. On the other hand you might consider publishing this letter to see what other readers think.

G. Wahlquist,
Botobolar Vineyard,
P.O. Box 212, Mudgee 2850.

THE SERVICEMAN

How Safe are Picture Tubes?

The question of picture tube safety, particularly in the average domestic situation, is one about which little seems to have been written of late. A particular incident, coupled with changes in picture tube "fashion" over the last few years, prompts me to devote this month's space to the subject.

Those of us who remember the early days of TV may also remember the trepidation with which we handled our first picture tube. We had been instructed, correctly, that an imploding picture tube could do a lot of damage and inflict nasty injuries. Among other things, we were cautioned not to scratch the glass, or strike it with hard objects such as screwdriver blades, pliers or the like.

Most of us took the warnings seriously and, I imagine, have retained a healthy respect for picture tubes ever since. On the other hand, familiarity, if it has not actually bred contempt, has made us less apprehensive and rather more realistic in regard to order of risk involved.

Personally, I have heard of only one serviceman who lost a tube by implosion while working on it. It was a colleague who was replacing a tube when it slipped from his grasp. Fortunately, he was able to jump reasonably clear before the big bang, and the only injury was to his nerves and profit margin.

Another colleague lost a couple of tubes, but in less traumatic circumstances. Both were re-gunned tubes and both showed a reluctance to accept the yoke on the neck, apparently due to a slightly oversize glass join. Thinking that he could coax the yoke into postion, my friend tried a little gentle pressure. The next moment there was a hiss of air and the tube was a write-off. After the second time, he decided such tactics were not worth the risk.

While the serviceman might be exposed to a certain amount of risk in such circumstances, most of us felt that the customer, in the normal home viewing situation, was well protected. The tube was installed behind a safety glass which performed the dual function of protecting the viewer from the picture tube and the picture tube from the viewer — particularly the inquisitive junior variety. The worst that could happen, it was reasoned, was that an imploding picture tube would damage the set, but nothing more.

In fact, we may have been deluding ourselves. There was no guarantee that every manufacturer would do the right thing in regard to safety precautions. One I heard about used plain glass instead of safety glass. As a result, on the one occasion it was needed, it shattered along with the picture tube and contributed its own share to the damage. Fortunately, this was not too serious.

Another fitted the correct safety glass, but so flimsily supported as to be virtually useless. When the crunch came it finished up on the opposite side of the room. Again, fortunately, the consequences were not serious.

Then came the picture tubes with the bonded face plate. Most of us, while appreciating the numerous advantages of this design — ease of mounting, absence of reflections etc — tended to regard the face plate as just another form of safety glass. While this may have been something of an over simplification of the design philosophy, we still felt reasonably confident that the viewer was adequately protected.

Next came the rim banded tube. Suddenly the picture tube face was right out in front of the cabinet, with nothing between it and the viewer. Was the viewer safe from the picture tube? Was the picture tube safe from the viewer?

According to the philosophy behind the design of this tube, as explained by the manufacturers, the answer to both questions was yes.

Which brings me to a letter which the editor received from a fellow serviceman,

Above: This view was taken from near the TV set. It shows the chairs normally used by the adult viewers and the area, approximately that occupied by the rim band, where the children were seated on the floor a short time before the implosion.

Left: The scene after the implosion. The major remnant of the tube is in the immediate foreground and both the rim band (white) and the tension band (darker and narrower) can be seen.

and which he passed over to me. Here is what he says:

Dear Sir,

The following story about a picture tube might interest you.

At 9.30pm my phone rang. An excited lady (one of my customers) blurted out: "My TV set has blown up." Knowing that many people, women in particular, use the expression "blown up" to describe a variety of conditions, I didn't take this too literally.

But after trying to calm her and avoid a night call she said: "But I can't leave this glass all over the floor all night." Then I knew she meant it. I said, "I'll be right out."

Sure enough, the front and back of the console TV set was blown off and the metal band, glass, etc, was strewn all over the room. The lady was standing by, broom in hand, ready to clear it up. I advised her to wait. It occurred to me that the matter of compensation, not only for the tube, but the entire set, had to be considered. It would be a good idea to have some photographs to back any such claims.

It was now about 10pm. My camera was at home — and empty. I made various phone calls in an effort to locate a friend with a spare roll of colour film. Finally found one. I drove back home, about eight miles, for my camera, then on to my friend's place to pick up the film.

Finally, I arrived back at the disaster scene and took six flash shots. Then I helped to clean up the mess and finally sat down about midnight to a welcome cup of coffee which the lady provided.

I have been in touch with the manufacturer of the picture tube, a rim banded 25in type, only about two months old. The glass remains have been forwarded to his laboratory for a complete analysis and investigation.

The owner is naturally upset. His three children were sitting about 7ft in front of the set a short while before the accident. He points out that they would have been severely injured if they had not gone to bed when they did. At a lesser level he is also upset about the damage to the set. He feels the set will have been irretrievably damaged and that he should get a new set, not just a tube and repair.

Exactly what is the philosophy behind the rim banded tube? In particular what protection does it have against abuse by those who use it? Suppose the housewife elects to clear the faceplate with an abrasive cleaner? Some cases have been reported where tubes have cracked (without any violent reaction) due to this cause and, significantly, have cracked along the line where the escutcheon meets the faceplate. Apparently the escutcheon provides a guide along which the cleaning cloth is regularly drawn, resulting in repeated abrasion along the same line.

There is also the possibility that the housewife, again while cleaning the faceplate, may scratch it with the diamond in her engagement ring. I know of one woman who has a habit, while cleaning, of turning her ring so that the stone is to the front of the hand, presumably to protect it. As a result she has left several scratches on the windscreen of the family car — and on the safety glass of the TV set.

Another risk is little Willie. He is likely to do anything, from running the wheels of his toy car up and down the face of the tube, to attacking it with something from Daddy's tool kit. Can a tube take this kind of abuse?

The tube manufacturers' answer is that (a) these possibilities, and others like them, were very seriously considered before this form of tube was approved for release to the public, and (b) these tubes are designed so that, even when they fail due to abuse of this kind, they will merely crack, allow air to enter at a controlled rate, and become harmless.

For those not completely familiar with the rim banded tube, a brief description of a typical type may help. Initially, it is a conventional type tube, the banding being almost the last operation before the tube is packaged.

The first thing to be fitted is the rim band. This is a mild steel strap, usually zinc plated, about 2½in wide and made in two pieces, each approximately half the circumference of the tube. These are fastened to the edge of the faceplate with epoxy resin.

Next, a metal lug is fitted at each corner of the faceplate rim outside the rim band. These are held in place by a jig in readiness for the next operation.

This is to fit the tension band. Its more obvious functions are to hold both the mounting lugs and the rim band in place, although the latter will ultimately be held by the epoxy when this sets.

In appearance the tension band is similar to the mild steel strap used to bind crates and bales, and it is tightened and clamped in a similar manner. However, whereas the storeman generally uses a manually operated tool, and his own judgment as to when it is tight enough, the tube band is tightened by a power operated tool designed to apply the right tension automatically.

Nevertheless, all those who witness this process for the first time admit that it is a frightening experience, for the pressure applied to, and by the band is obviously very high.

Yet the truth is that, far from adversely stressing the tube, it is designed to relieve existing stresses. The picture tube has to withstand the pressure of the atmosphere over its entire glass surface, the largest "flat" area being the faceplate. In fact, this is not truly flat, being deliberately bowed outwards to provide added strength.

Nevertheless, there is a considerable pressure being applied over this total area, tending to force the faceplate inwards. On the other hand the tension of the band around the edge of the face plate creates the opposite effect; a tendency to force the faceplate outwards. Thus the tension of the band actually relieves the faceplate of some of the task of withstanding the atmospheric pressure.

More importantly, from the safety angle, it so strengthens the tube around its outside edge, that it should withstand a failure in the glass, irrespective of the cause, without disintegrating with catastrophic violence. While the faceplate may crack, and admit air, it should otherwise remain substantially intact.

I say "should" because, quite obviously, in the case in question it did not. Something went wrong. Exactly what may never be known for, while there is every likelihood that the cause of the initial failure will be identified, this may still not reveal why the tube reacted violently instead of passively, as it was supposed to.

In fairness, it must be stated that the tube manufacturing industry exhibits a very high sense of responsibility in this regard. In addition, they are well equipped both to maintain a high quality in the product itself, and to investigate the cause of the rare failures which do occur.

In this latter regard, for example, laboratory technicians can determine, quite positively, the cause of any tube failure providing all the glass can be salvaged.

At the manufacturing level, there is constant exercise of quality control. In addition, at frequent intervals during a production run, sample tubes are selected at random and deliberately "tested to destruction".

The test is made by hitting the faceplate of the tube with a steel ball of prescribed size, travelling at a prescribed speed. While such a test can reveal many things, one of the most important is the tube's ability to fracture without creating a violent reaction.

But, in spite of all the care which can be exercised at the manufacturing and testing level, no one is prepared to say that there is not some element of risk; a risk that an isolated tube, if it fails, may not fail in the manner predicted. Which raises the question, how much risk? Again, no one is prepared to say and, in truth, such a figure may be impossible to determine. Doubtless this case we are discussing will become a vital statistic in any future attempt to determine such a figure.

The only thing on which all sections of the industry — including servicemen — seem to agree is that the risk is extremely small. Some go so far as to say "infinitesimal" but this may be too strong a word.

About the closest thing to a figure which has emerged from all the discussions I have had seems to be in the order of one or two in one million, but it must be emphasised that this is a very rough estimate.

In any case, it would seem to very small compared with, say, the risk of mechanical failure in a car causing a serious accident, remembering that mechanical failure is low on the list of accident causes. And, while statistics are usually cold comfort to the victim, we have to take the realistic attitude that almost everything we do involves some order of risk. Some, like riding in a motor car, involve a very high order.

The real question, I think is whether the risk, no matter how small it is, can be lessened still further by any practical or economic means. For example, should the safety glass or bonded face plate be retained? The tube manufacturers point out, correctly, that the safety glass is only as good as the set manufacturer makes it, by using the correct type of glass and fitting it correctly.

On the other hand, anything in front of the picture tube and which protects it from the kind of user abuse already discussed, must surely lessen the risk of it failing in the first place. On that basis alone it might well be justified.

Microwaves for the radio amateur — 6

The final article in this short series of articles written to stimulate activity on the amateur microwave bands. The author continues the description of a practical 10,000MHz station, and concludes with advice for those thinking of building up a system.

by DES CLIFT, VK2AHC*

There are three sections in the IF system, each a physically enclosed and screened sub unit — viz. IF pre-amplifier, main IF Amplifier, and limiter discriminator. For ease of understanding these will be described in reverse order.

Limiter Discriminator. This consists of a four stage broad band amplifier using high gain-bandwidth transistors type BSX19 (2N2369). Between adjacent pairs back to back fast, low-capacity silicon diodes are fitted, and these constitute the limiting devices. The output of this chain is fed, via an isolating network, to a further pair of BSX19s whose collector loads are tuned to 25MHz and 35MHz respectively. Each feeds a rectifier diode, the outputs of which are combined and fed to the audio amplifier. This latter arrangement constitutes the discriminator and contains the only tunable components in the limiter discriminator module.

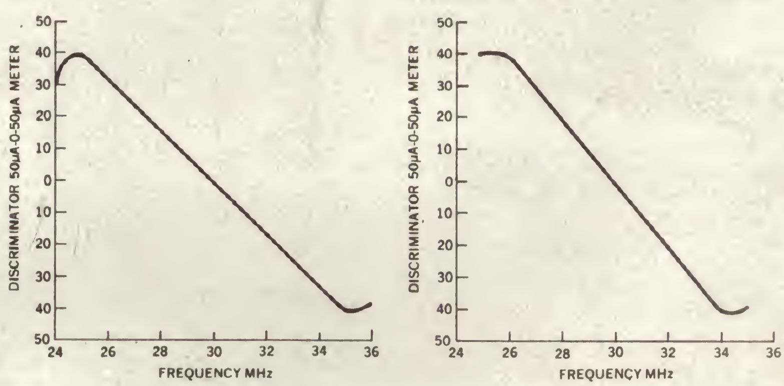
A rather "brute force" method of achieving a very linear characteristic for the discriminator was evolved, by having L, C and a low value loading resistor all variable. The electrical centre of the output network is determined by a potentiometer, and since the voltage at this point is, of course, (within the linear range of the discriminator), proportional to the input frequency, it is also a convenient point to insert the tuning meter, which is a centre zero ±50uA meter with a series resistor such that it reads about 0.35V peak to peak full scale. The normal maximum reading, with full limiting taking place is about two thirds of this. The discriminator characteristic is shown in Fig 21(a).

The prototype limiter discriminator used (BF115s), and performed very well except that it was difficult to achieve more than ±4MHz. It was for this reason that the BSX19 was used in the second model, with the immediate result that just over ±5MHz with better linearity was achieved. Experience has shown the BF115 version is adequate for use with the more stable klystrons of the CV2282 variety, but the BSX19 version is possibly better for 2K25 / 723 A / B's. Some extra gain is available with the BSX19 strip, but this is of no real consequence since adequate IF gain is provided by the circuit about to be described.

*12 Romford Rd, Frenchs Forest 2086.

Both versions were lined up with a conventional signal generator, and later checked against a sweep generator. The results were almost identical although of course the latter method was by far the easiest and gave a lot more information about the out of band responses.

The construction of the limiter discriminator is very simple. A piece of cheap single sided laminate board using Zephyr pins has the components laid out in a manner following the actual circuit. The BSX19 version uses small heat sinks; it takes approximately twice the current of the prototype, and is completely enclosed in a screening box.



(a) 2N2369 UNIT (b) PROTOTYPE BF115 UNIT

DISCRIMINATOR CHARACTERISTICS

Fig 21: Characteristics of both the author's discriminators.

Intermediate Frequency Amplifier: This operates at 30MHz and is broad banded to have a response flat to ±3dB over at least ±4MHz (±2.5MHz in the prototype). The design is based on that given in the Motorola Data Book on integrated circuits, and uses 3 MC1550G HF integrated circuits.

It exceeded all expectations both as to simplicity of construction and, after some initial teething troubles, the achievement of the desired performance. In order to gain experience in this relatively new field the writer decided to build the prototype IF strip to one design given in the data book, and the second version to an alternative design in the book and compare the results.

Design 1 in the data book is a three stage stagger tuned arrangement using four tuned transformers capable, it is claimed, of a 6MHz bandwidth at 45MHz centre frequency and having a controlled gain between 6dB and 70 dB. After conversion of the design parameters to a 30MHz centre frequency, and construction in a carefully screened three partition box, it was found impossible to secure stable performance despite the later aid given by a sweep generator.

A compromise was therefore made, by replacing the two centre tuned transformers with small broad band toroids. This immediately gave the stability required with a gain of 50dB, controlled by the application of a variable voltage to pin 5 of the first MC1550G. It was decided to settle for this and secure the extra IF gain required in the IF pre-amplifier.

Design 2 in the data book deals with a two stage amplifier, also for 45MHz but with a gain of only 30dB over a 15MHz band. The bandwidth is achieved by the simple process of resistance loading the tuned circuits which in this case are simple parallel tuned circuits.

Conversion of this design to 30MHz, with a bandwidth of 8MHz or more showed that three stages would be required. This was adopted and produced with a slightly less complicated screening arrangement than in the prototype. The adjustment of the loading resistors was made on the basis of stability, and surprisingly enough, the desired result was achieved with a gain of nearly 60dB. Gain control in this case, as in the data book, is by application of a variable voltage to pin 5 of all three stages.

The writer's conclusion is that the parallel LC loaded version is by far the easiest to produce and tame, and certainly will be used in future versions.

In both versions the MC1550G's are mounted in "holders" forming part of the

THE POWER RACE IS ON

MSP *Hi-Flux* Speakers - *30 Watts*

MSP announce their entry into high powered speaker manufacture with three 30 WATT RMS additions to their wide Hi-Flux range.

In the 60's 10 watts amplifier power was the upper limit. Now in the 70's with solid state devices 30 watts has become commonplace for commercial applications.

Now you have a choice!

For hi-fi a new range of speakers —

8" Woofer
LF — 8WAC/30/8 Pt. No. 56407-003
LF — 8WAC/30/15 ,, 56407-001

12" Woofer
LF — 12UAC/30/8 ,, 56437-001
LF — 12UAC/30/15 ,, 56436-001

And for electric guitar applications a new 12" range —
12PQC/30/8 Pt. No. 56443-001
12PQC/30/15 ,, 56442-001

To ensure continuous high power handling, we life tested the 12PQC at 30 watts RMS in a two cubic foot sealed enclosure at 50 Hz.

For recommended enclosure designs including the application of mid-range speakers and tweeters, post coupon to your nearest distributor.

NEW SOUTH WALES
George Brown & Co. Pty. Ltd.
247 Sussex Street, Sydney. 2000.

VICTORIA
Amalgamated Wireless (Australasia) Limited, Miles Street, Mulgrave. 3170.

QUEENSLAND
Chandlers Pty. Ltd. 399 Montague Road, West End. 4101.

SOUTH AUSTRALIA
Newton McLaren Ltd. 82 Gilbert Street, Adelaide. 5000.

WESTERN AUSTRALIA
Amalgamated Wireless (Australasia) Limited, 231 Bulwer Street, Perth. 6000.

TASMANIA
Amalgamated Wireless (Australasia) Limited, 123 Murray Street, Hobart. 7000.

Please send me further information on the MSP range of 30 Watt speakers.

Name ....

Address ....

....

State ....

Postcode ....

MANUFACTURERS SPECIAL PRODUCTS PTY. LTD. 47 YORK STREET, SYDNEY, 2000. PHONE 20233 msp

printed circuit board chassis in a manner that most of the transistors in the equipment are in fact mounted. A pilot hole is drilled with a N0 50 (or thereabouts) drill. A tool, similar to an end mill, but made from a discarded ¼" drill is then used to take away the foil. The small hole is then opened out to take the appropriate pin. In the case of the IC's, the tapered Zephyr pins designed for the small matrix board are used.

The convenience of this method of construction is that one can put in the holes as one progresses along the circuit. It therefore produces a very neat prototype arrangement without the need for etching.

Pre-IF Amplifier: The outboard pre-amplifier for the IF system serves two main purposes, viz,

(i) It provides a most efficient and low loss method of transferring the very low level IF signal developed in the mixer crystal to the main IF amplifier.

(ii) It provides sufficient extra IF gain so that experiments can be performed to determine the optimum settings of both the pre-amplifier and main IF amplifier gain controls, and if necessary introduce additional attenuation between the two, or between the main IF amplifier and limiter discriminator.

The latter step was thought advisable in view of the possibility of instability in the IF system as a whole, and has proved quite a useful feature. As shown in Fig 20 the output of the crystals is fed, after filtering off the DC crystal currents, to a low noise BF 180 amplifier with a bandwidth of some 15MHz. This is operated as a variable controlled gain stage and has its output fed to an emitter follower which in turn feeds the main IF amplifier by a length of 50ohm coaxial cable.

Initial experiments have confirmed that the main IF Amplifier and limiter discriminator of the design of the second set of equipment really are sufficient for all but the most distant contacts and the pre-amplifier is therefore a bit of a luxury which could be added later when the feel of the system has been obtained. However it does appear that the pre-amplifier is a necessity with the prototype set. This pre-amplifier is of slightly different design, and fed from a single crystal mixer used a pair of TIXMO5 low noise germanium transistors operated in a cascade arrangement, and also working into an emitter follower and thence the Main IF Amplifier. Its circuit is also shown, for general information (see last month.).

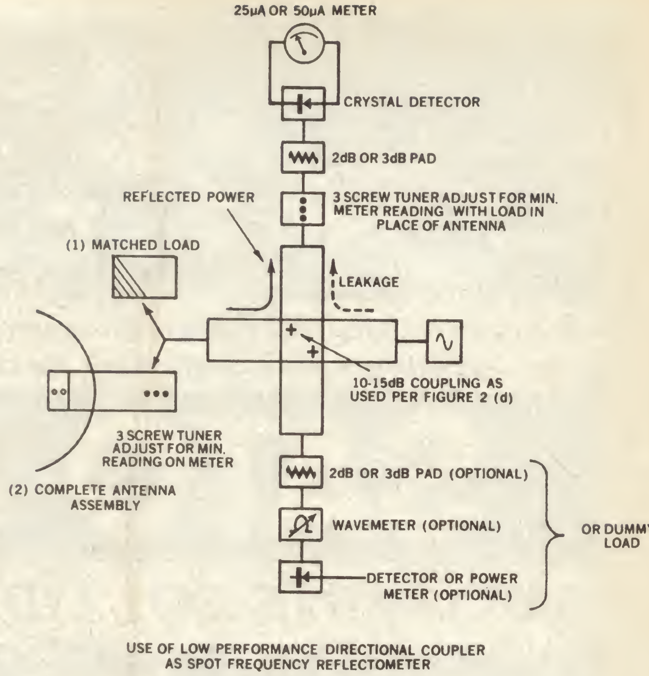


Fig 22: Showing the use of a low performance directional coupler as a spot frequency reflectometer for adjusting matching of the aerial.

Microwave system: Two 17" diameter parabolic reflectors using feeds to the design of Fig 16 are used in the complete system. They have gains of approximately 30dB and a beamwidth of between 4° and 5°.

The upper parabola is firmly fixed to the main framework of 1¼" x 1¼" x ⅛" aluminium angle, whilst the lower parabola is fixed to it in the same manner but via four double coil spring washers. Thus the tensioning of the screws through these washers gives a fine degree of movement. In the first instance, and before the feeds are fitted, the perimeters of the two parabolas are adjusted to be flush by placing them face downwards on a large flat surface.

The klystron feeds the top parabola after having some 5mW of its power extracted via the directional coupler, which is of the type illustrated in Fig 10. In order to present a very good match to the klystron a three screw tuner is built into the feed and this is adjusted with the feed and parabola in their assembled form. A dummy load of the type shown in Fig 11 normally terminates the unused side arm of the coupler. For test purposes, a signal can be fed in at this point, by substituting either a waveguide adaptor or a waveguide to coaxial transformer for connection to the signal generator.

The antenna feed can also be adjusted for minimum reflection, as follows:

(i) Connect the coupler as shown in Fig 22, and use as sensitive a meter as is available. Note that the aerial is replaced by a good matched load. The addition of the wavemeter and power meter to the lower side arm is not essential. If these are not available, replace the normal waveguide to coaxial transformer by a dummy load.

(ii) Adjust the screws on the upper side arm for a minimum reading on the meter. What is being done at this stage is to cancel out the leakage component which is due to the fact that this type of coupler does not have a high directivity. This screw setting only holds at one frequency and the procedure must be repeated if the frequency is changed.

(iii) Replace the complete antenna (feed and parabola), and point it towards free space, then adjust the three screws on the rear of the feed for minimum reading on the meter.

(iv) Replace the dummy load on the upper side arm of the coupler, and the waveguide to coaxial transformer on the lower one, and the assembly is back to normal.

In this equipment the klystron is a CV2282 with a direct waveguide connection so it is bolted straight onto the rest of the assembly. It is enclosed in a brass box to exclude draughts and temperature changes which do affect the frequency of reflex klystrons, particularly the 2K25 series. These can easily be "blown" 10MHz off tune!

The incoming signal is collected at the focus of the lower parabola and is fed to the 3dB coupler where it divides equally, and enters the twin crystal mixer cavities. At

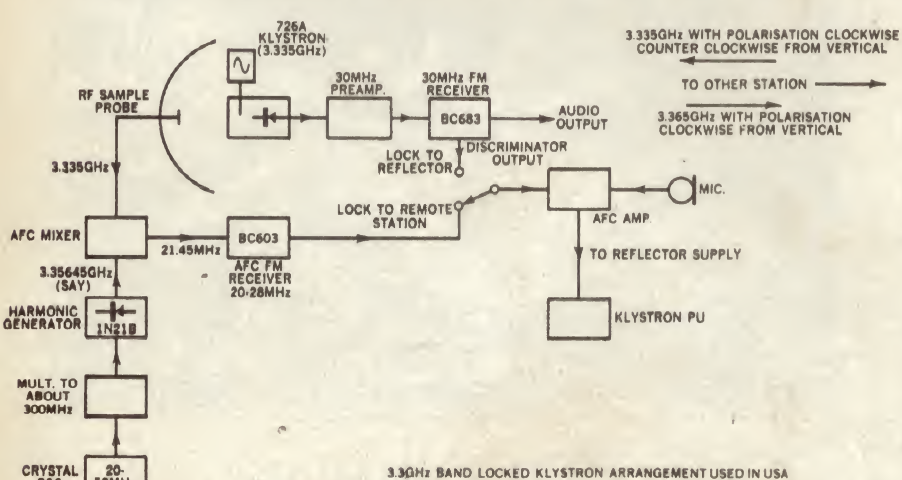
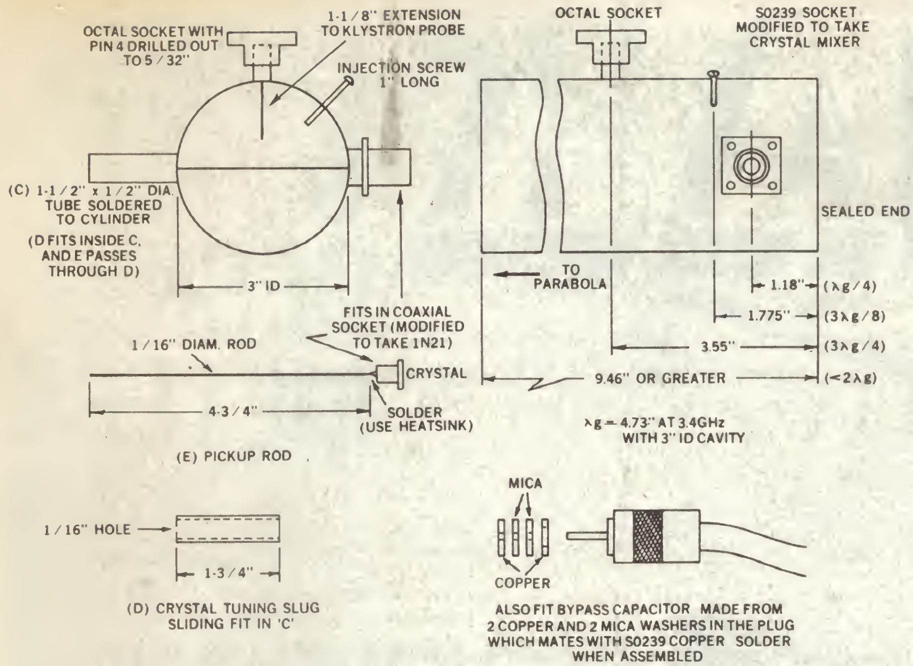


Fig 23: Basic details of the locked klystron scheme used by some US amateurs on the 3300MHz band.



CONSTRUCTION OF 3.4GHz POLAPLEXER (TAKEN FROM QST JUNE 1963)

Fig 24: The construction of a polaplexer for use on the 3300MHz band, taken from an article in the June 1963 issue of "QST."

the same time the local oscillator signal which is, of course, separated by 30MHz from the incoming signal, is fed to the 3dB coupler by the waveguide to coaxial transformer. This signal also separates equally and enters the mixer cavities. The output of the crystals at the IF is roughly the same as that which would arise from a single mixer, but with the added advantages that there is a considerable amount of isolation (10 — 20dB) between the signals and local oscillator, and that there is a considerable cancellation of local oscillator noise.

Other systems in use by amateurs: The equipment described in the previous sections is representative of that used by the majority of amateur microwave stations throughout the world. An alternative to the use of "free running" klystrons is the system evolved for use in the 3300MHz band by a group of US amateurs. Since this system also uses the polaplexer technique referred to previously, a block diagram and a few notes will be included.

Figure 23 illustrates the techniques of locking klystron to either the harmonic of a local crystal oscillator / multiplier chain, or to the signal received from a remote station so equipped. Its main advantage is that it allows the use of narrow band IF amplifiers (the surplus units referred to in the original QST article could, no doubt, be replaced by one of the many similar mobile FM radios which are available at present), with consequent improvement of overall system performance. It suffers from the disadvantage that it is a little more complex, but is well worth considering for really long distance contacts.

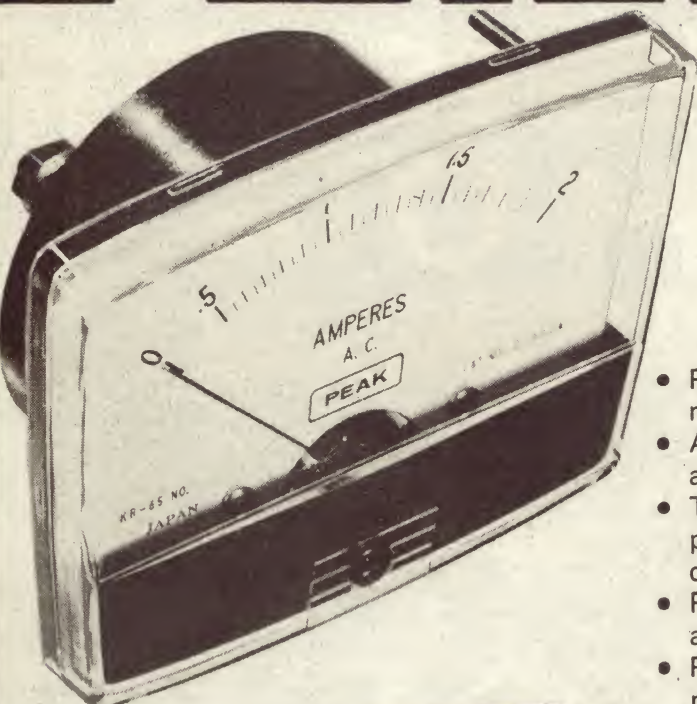
Figure 24 illustrates the construction of the complete microwave assembly for a 3300MHz polaplexing system. It is obvious that its simplicity requires little more than the klystron and a suitable reflector, in order to be able to put oneself on the air. This technique should certainly be considered seriously for use at both 2300 and 3300MHz in Australia.

An article in QST November 1963 describes some equipment for 10,000MHz which is really the ultimate in complexity as far as the amateur is concerned. It uses direct crystal control of a klystron multiplier fed from a 2000MHz multiplier chain ending up in 2C39A and 3CX100A5 triode stages. The writers of the article are to be complimented on their enthusiasm and are quite correct in making the point that an overall system gain of up to 40dB could be achieved by such a system working into a narrow band communication receiver.

It is felt, quite sincerely, that such equipment is not truly representative of the average worker in this field. However, a careful assessment of the many features of equipment from all sources should be made by the amateur intending to participate in the microwave field, as over the years some positive contributions to the science of radio communications have been made in the amateur fraternity and not all these techniques date as easily as some of their lower frequency equivalents.

In concluding this short series of articles, it is hoped that they may have served to stir up interest in the idea of experimenting on the microwave bands. If only a few readers have been encouraged to try their hand at amateur microwaves, the effort of the writer in producing the articles will have been worthwhile.

PEAK PANEL & DESK METERS



- PEAK Panel-Meters are attractively styled and represent top-quality at keen prices.
- A.C. & D.C. Voltmeters & Ammeters are available in a wide selection of ranges.
- The model stocked is the KR-65 Series in 45 popular ranges. Alternative models or special calibrations are available to indent order.
- Plastic cases for conversion to desk meters are available.
- Peak Panel-Meters are guaranteed for 3 months and are backed by excellent service facilities.

- PEAK Desk-Meters are designed for student and general laboratory use.
- D.C. Voltmeter, Ammeters and Galvanometers are available in a selection of ranges.
- They are accurate, robust and display a clear scale.
- 4mm captive head, socket type terminals.
- Fitted with Diode overload protection device.
- Moulded slant front case totally enclosed.

H. ROWE & CO. PTY. LTD.

sole australian agents

adelaide hobart perth brisbane melbourne sydney

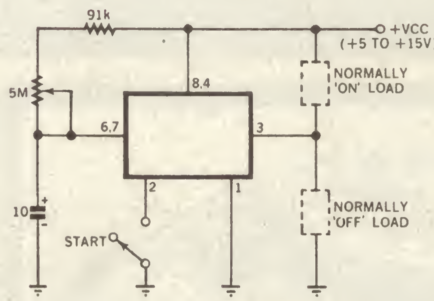
CIRCUIT & DESIGN IDEAS

Interesting circuit ideas and design notes selected by the Editor from technical literature, reader contributions and staff jottings. As they have not necessarily been tested in our laboratory, responsibility cannot be accepted. Contributions to this section are always welcome.

Versatile Electronic Timer

The Signetics NE/SE 555 monolithic timing circuit is a highly stable controller capable of producing accurate time delays, or oscillation. This universal timer will produce fully controllable time-delays between one microsecond and one hour. If the timer is allowed to run free, it can be set to oscillate at any frequency between 1MHz and one pulse per hour. All that are required are an external resistor and a capacitor; the timer is internally compensated for component tolerances and temperature drifts. The temperature coefficient is excellent — approximately 25 parts per million per degree Celsius.

Intended for wide-ranging uses that include automobiles, home appliances, industrial control systems, and sophisticated electronic equipment, the timer can be used



specifically for simple time delay, time sequencing, pulse generation, missing pulse detection, frequency division, pulse width modulation, pulse position modulation, etc.

Internally, the timer consists of two comparators, a flip-flop, and a buffered output stage. The output structure can source or sink up to 200mA, which means that it can drive standard TTL circuits. These loads can be connected either to the "Vcc" terminal or to ground. Both "normally on" and "normally off" loads can be driven because the output stage is an inverting type which uses two high-current transistors.

The diagram shows the circuit connected as a manually started photography timer. The time can be set in the range from 1 to 60 seconds with a potentiometer. Two loads, one normally "on", the other normally "off" can be connected to the circuit simultaneously. In this application the circuit could power a relay, a small lamp, or a controlled rectifier. (From Signetics News. Available from Tecnico Electronics, 53 Carrington Rd, Marrickville, NSW 2204).

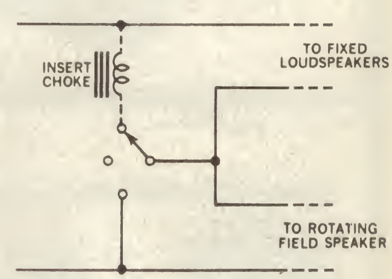
Modification to Single Channel Organs

There are many electronic organs in use nowadays which have only one amplifier channel but incorporate a rotating field loudspeaker system together with the main fixed loudspeaker(s). Switching of middle and upper frequencies may be done as shown in the diagram, which gives a choice of the main or rotating speaker systems separately or both together.

With the rotating field speaker system in operation, all is usually well in a large area such as an auditorium, due to the masking effect of reverberant sound. However, in a confined space such as a living room, and especially when reeds or strings are registered, the effect may become tiring to the listener. On the other hand, it may not be appropriate to switch off the rotating field loud speaker altogether.

The writer has devised a simple way around this problem by wiring a small inductor into the circuit such that it is effectively across the main speaker(s) when they would otherwise be shorted out to middle and upper frequencies. This allows sufficient of the middle and upper frequencies to be radiated by the main speaker(s) such that any objectionable effect of the rotating system is avoided. In fact, it tends to give a two-channel effect, with the flute-like tones coming from the rotating loudspeaker and the reeds and strings from the fixed units.

The inductor used was one normally used in transistor power supplies. It has a DC resistance much less than 1 ohm and an inductance of 15-20mH. This was found to be



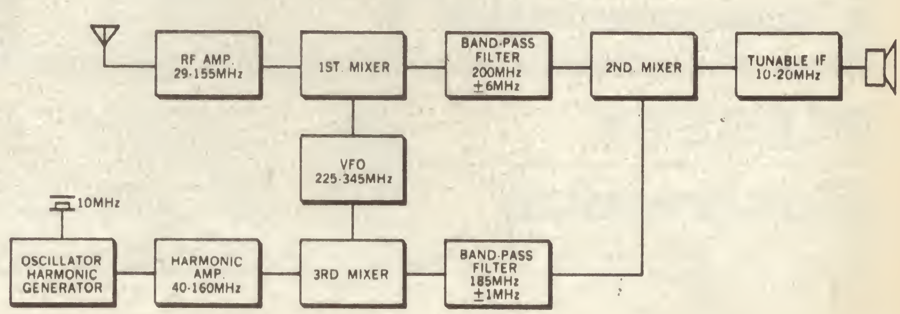
ideal when connected across a voice coil impedance of 4 ohms. For higher impedances, a proportionately higher inductance would be indicated.

(By Neville Williams, "Electronics Australia".)

The Wadley Loop for VHF

Another approach to VHF reception and one which appears to have some merit, is the Wadley Loop system. No doubt most readers have heard of the series of Racal receivers using this principle, as well as the Deltahet produced by Ian Pogson of "Electronics Australia". The problems involved in producing a receiver to cover the range 30-150MHz are certainly not insurmountable using currently available techniques. A block diagram shows the arrangement.

There are two major departures from the converter-tunable IF configuration. Firstly,

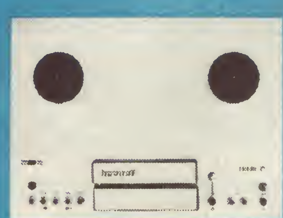


BRENELL *famous recording equipment...from*
PLESSEY

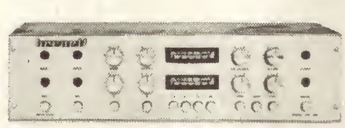
Brenell ST400 stereo recorder

Brenell Mark 6 stereo recorder

Brenell Type 19 tape deck



Brenell tape link amplifier



The range of famous Brenell high fidelity magnetic tape recorders, decks and amplifiers for hi-fi enthusiasts and professional users is available in Australia through Plessey.

Brenell ST 400 four-track, three speed stereo recorder. A fully transistorised unit with power amplifiers and inbuilt speakers offering exceptional quality in terms of recording and playback characteristics. 6 watts RMS per channel output, 40 Hz to 14 kHz ± 2 dB frequency response, 56 dB signal to noise ratio, less than 0.08% wow and flutter, bass and treble controls effective both during recording and playback. Also ST 200 two-track stereo version.

Brenell Mk 6 hi-fi stereo recorder. Unquestionably one of the world's most versatile tape recorders for semi-professional users, it is available for two-track or four-track stereo or as a complete monaural unit including inbuilt speakers. Fully transistorised, three motors, three heads, four tape speeds, full mixing and A/B comparison facilities. 15 watts RMS per channel output, 40 Hz to 22 kHz ± 3 dB frequency response at 15 ips, wow and flutter less than 0.05%, signal to noise ratio 56 dB unweighted.

Separate tape decks and amplifiers. For specialists wanting to build up their own systems, Brenell offers high quality tape decks and amplifiers as separate components. The Mk 6 deck is for hi-fi systems, the professional, solenoid-operated Type 19 deck handling up to 10½" reels is designed for industrial and scientific use. Transistorised hi-fi tape link amplifiers for stereo or mono operation are also available.

brenell

PLESSEY Electronics

For further information, contact:
Plessey Electronics Pty Limited Recording Equipment
91 Murphy Street Richmond Victoria 3121
Telephone 42 0431 Telex 30383
NSW Faraday Park Meadowbank 2114 Telephone 80 0111

Distributors: Qld: L. E. Boughen and Co 30 Grimes St Auchenflower 4066. **SA:** Roger Electronics PO Box 3 Bodbury North 5092.
WA: Athol M Hill and Co 1000 Hayes St Perth 6000. **Tas:** United Electronics 23A Frederick St Launceston 7250

AV51

up-conversion is used followed by down-conversion to a tunable IF and secondly, a VHF VFO is mixed with harmonics of a crystal standard in such a way that frequency drift or setting error of the VFO is cancelled.

In this design I have chosen a 10MHz tuning range as being a good compromise in frequency readout and tuning range. With a 200-1 or 300-1 reduction dial a readout of 50kHz per revolution or better can be achieved. A readout of 1kHz or better is attainable, depending on dial size.

The RF amplifier need not be a wide band stage covering 29-155MHz as shown but may be a wide range tunable amplifier. The 200MHz and 185MHz bandpass filters and amplifiers should present few design problems apart from that of physical layout to achieve stability.

The mixers could provide most of the headaches. I believe hot-carrier diodes would provide about the best solution in a ring configuration. I have seen spectrum analysers using this technique that cover a wider frequency range and a dynamic response much greater than is necessary in this application.

The crystal oscillator, harmonic generator and amplifier lend themselves to several novel solutions. The more or less standard method of clipping the 10MHz oscillator output and amplifying all harmonics could be done but I doubt its success. A Comb generator may be a better proposition. The VFO may employ more or less standard techniques so that a relatively constant output and a stability of $\pm$1MHz are achieved. The tunable IF covers the range 10-20MHz and is another subject entirely.

I hope I have whetted your appetites. Perhaps you have other ideas on the subject.

(By R. Harrison, VK2ZTB, in 6up, journal of VHF Group, WIA, NSW Divison.)

Editorial note: We do not necessarily agree with all the comments above but at the same time, the overall scheme appears to have considerable merit. The author of the Deltahet series, although very interested, prefers to stand aside and let someone else have a go on this one!

An Oscilloscope Calibrator

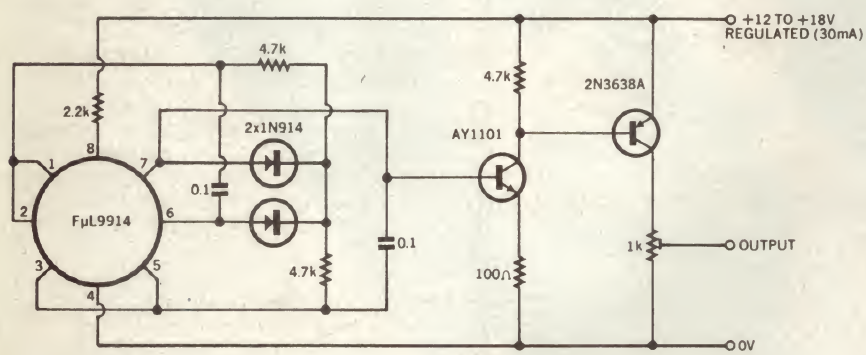
The calibrator illustrated generates a 10V P-P square wave of approximately 1KHz. The rise time is less than 1uS when working into the normal 1M, 50pF input of an oscilloscope.

This device may be of use to those who own an oscilloscope without a calibrator, or those who wish to upgrade the 50Hz, 100uS rise time calibrator common to many instruments. It is possible to use this calibrator for the adjustment of attenuators, up to the 10V / cm position.

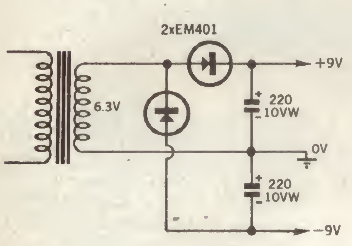
An interesting feature of the circuit is the use of the FuL9914 for the astable multivibrator section of the calibrator. Good performance is obtained by using this device, provided a stable resistor is included to drop the supply voltage to approximately 3.6V required for the IC. If desired, discrete transistors could be used in place of the IC.

(By Mr M. Daley, Dactyl Road, Moorabbin, Victoria 3189.)

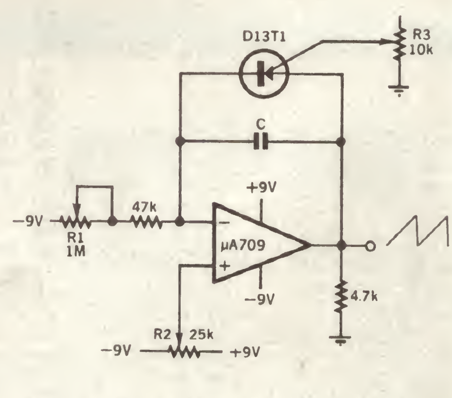
(Editorial note: This unit could be used both as a frequency and voltage calibrator, provided that it is fed with a stabilised supply and that access could be obtained to a means of initial calibration.)



Linear Sawtooth Oscillator



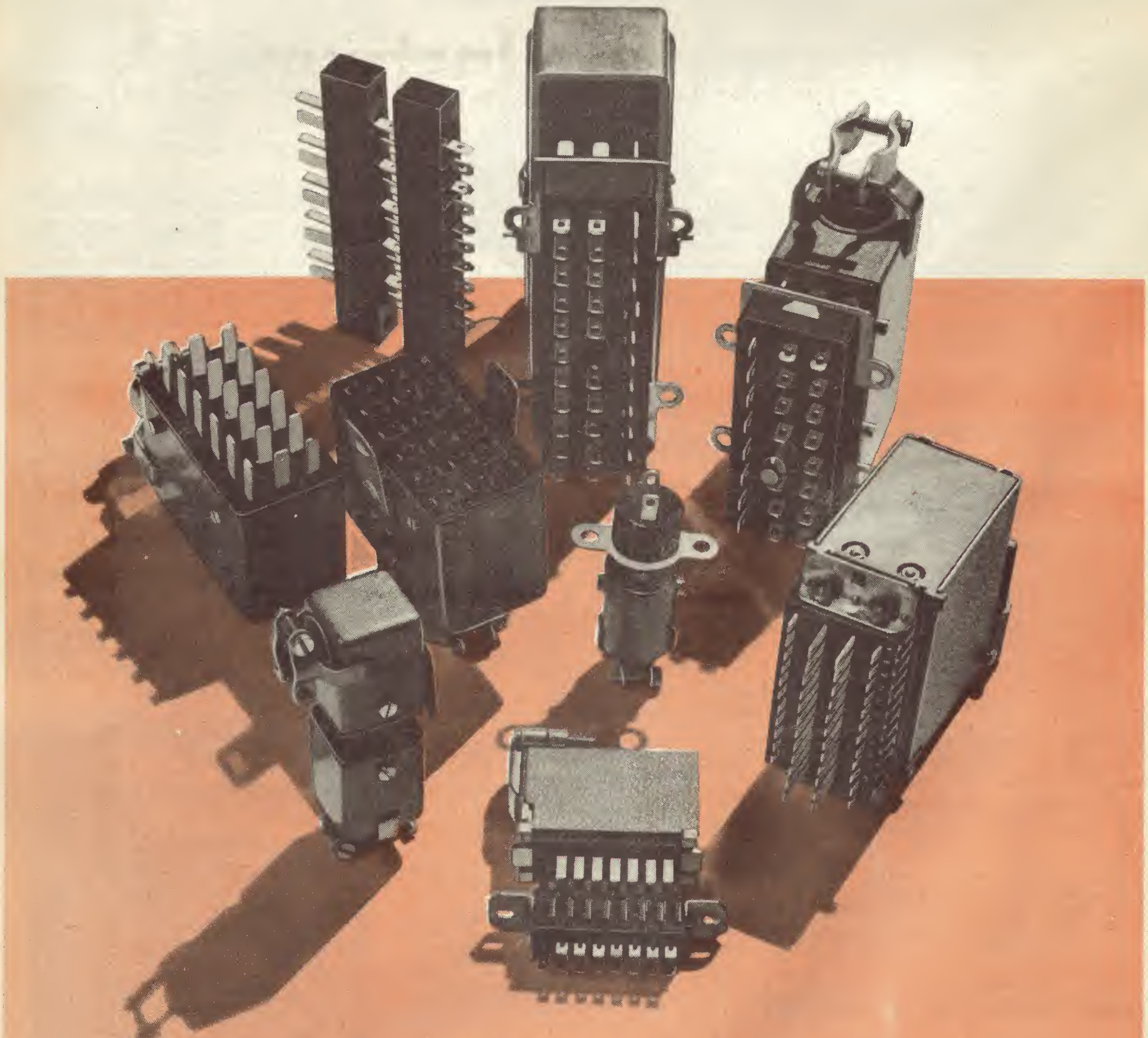
POWER SUPPLY



Here is the circuit of a sawtooth oscillator which produces an extremely linear ramp at frequencies from about 0.1Hz to in excess of 100KHz. The circuit is an OP-amp integrator plus a PUT to discharge the feedback capacitor. R1 & C determine frequency, R2 sets output zero, R3 sets PUT gate voltage and hence the breakdown voltage of the PUT and thus sets amplitude of sawtooth. The circuit of a suggested power supply is also given.

I have used this oscillator as a CRO timebase with excellent results. Other uses will suggest themselves.

(By Mr G. B. Donnan, Mt Moriac, Geelong, Victoria 3221).



Test & Measuring Instruments

Testing and measuring instruments — the moving coil meter and its use in measuring voltage, current and resistance — the multimeter or VOM — the electronic voltmeter, VTVM or SSVM — the cathode-ray oscilloscope, CRO or "scope" — oscillators and signal generators — measuring bridges — other less common instruments.

In many of the preceding chapters we have had occasion to mention a number of test and measuring instruments, such as the multimeter, the oscilloscope and the signal generator. It would therefore seem wise at this stage to spend a little time looking at the various measuring instruments used in electronics, to give the reader some idea of their operation and use.

A basic component in many measuring instruments is the moving-coil meter. This is a device which has an indicating pointer so arranged that, when a current is passed through the meter, the pointer moves along a scale by an amount which is directly proportional to the amount of current flowing.

Figure 1 gives the general idea, and may be used to explain how the moving-coil meter works. The heart of the meter is a rectangular coil of fine insulated wire, pivoted at opposite ends on jewelled bearings so that it can rotate. Current is fed through the coil via two delicate spiral springs, one at each pivot. The springs also supply what is known as the "restoring torque," which will be explained in a moment.

Attached to the coil is a long but extremely light and delicate pointer, along with a set of three short arms and small weights. These are used to counterbalance the pointer so that the whole rotating assembly remains balanced, irrespective of the position in which the meter is mounted. The pointer moves over a dial plate having a measuring scale printed upon it.

Behind the dial plate is a strong "horseshoe" shaped permanent magnet; this is fitted with two pole-pieces which concentrate its magnetic field through the movable coil. There is also a cylindrical soft iron core arranged to be within the coil, but not to rotate. It is fixed, and serves to ensure that, no matter where the coil is, it always moves perpendicular to the magnetic field. This must be done if an evenly-spaced or "linear" scale is required.

In an early chapter, you may recall, we saw that a current flowing in a coil of wire produces a magnetic field; this is precisely what happens when current flows through the meter coil. Two magnetic fields are thus present around the coil — that due to the permanent magnet, and that produced by the current being passed through the coil.

The two fields interact, and the coil experiences a turning force or torque; it therefore tends to rotate and, in so doing, to move the pointer needle along the indicating scale. When it does this, the spiral springs begin to have an effect; coil rotation compresses one spring and expands the other, so that both springs tend to resist such movement. The further the coil rotates, the greater the force of "resistance" produced by the springs, which are all the time trying to restore the coil to its original position. Hence we say that the springs provide "restoring torque" as well as providing flexible connections to the coil.

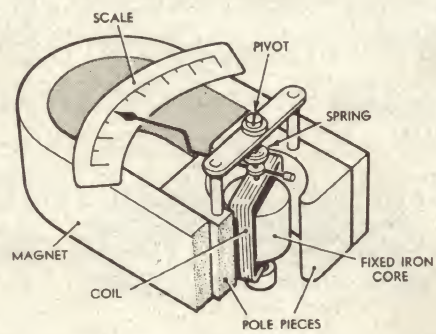
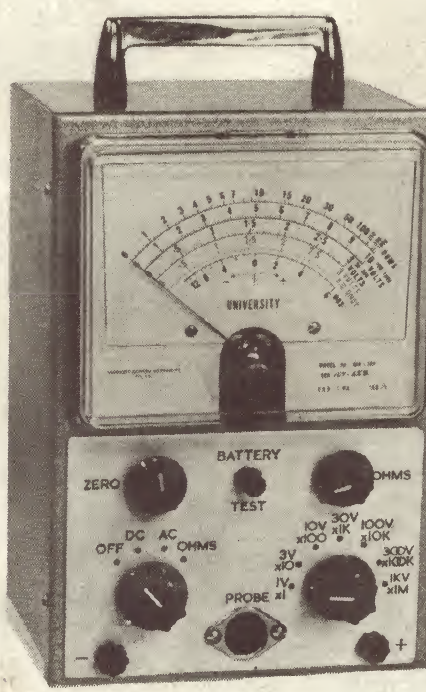


Fig. 1: A basic moving-coil meter.



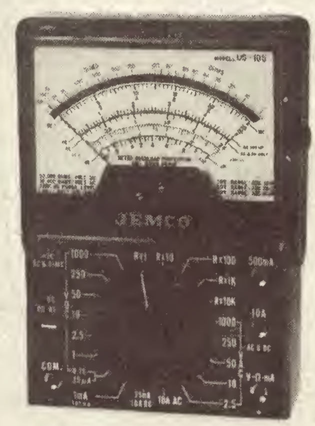
A modern solid-state voltmeter or SSVM, using FET devices.

The springs are thus fundamental to the operation of the meter. Because of their "proportional-to-angle-turned" restoring force, the coil and pointer are brought to rest at a point where the pointer needle indicates a value directly proportional to the actual current flowing.

If a strong current flows through the coil, its forward torque will be large and the coil will be able to rotate through quite a large angle before the restoring torque of the springs is able to counteract the current torque and bring it to a halt. On the other hand, a small current will only produce a small forward torque and the coil will only be able to move through a small angle before the springs are able to stop it.

For every value of coil current there will thus be a corresponding coil and pointer position, providing that the meter is not "overloaded" by passing through it a current greater than it is designed to handle.

The moving-coil meter can be used to measure very small orders of current. It can also be used to measure larger currents, as well as voltage and resistance, as we shall explain.

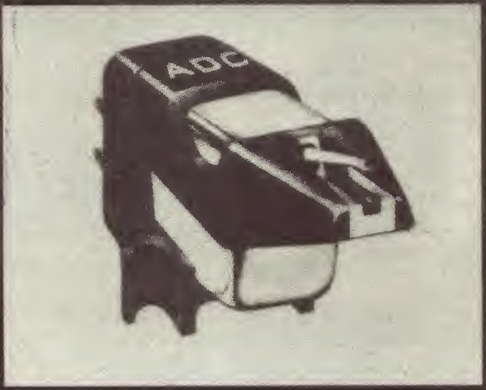


A typical modern multimeter or VOM. It features more than 20 ranges.

In passing, however, it should be noted that there are other types of basic meter movement beside the moving-coil type. These types are not as common as the moving-coil meter and, for this reason, they need not concern us here. It is sufficient merely to mention that they exist.

When we discussed Ohm's Law in an earlier chapter, we saw that resistances in parallel share any current which may be flowing. In fact, the proportion of the total current which flows through each of a number of resistances in parallel is inversely — and exactly — proportional to their resistance. The lowest resistance will

The ADC-XLM "...in a class by itself."



$77

That's the way Stereo Review described our XLM. High Fidelity headlined their review, "Superb new pickup from ADC" and went on to say, "...must be counted among the state of the art contenders." And Audio echoed them with, "The ADC-XLM appears to be state of the art."

With the critics so lavish in their praise of the XLM, there's hardly any necessity to add anything. Far better to let the experts continue to speak for us.

Frequency response The CBS STR-100 test record showed less than ±1.5dB variation up to 20,000Hz. *Stereo Review*
...response is within ±2dB over the entire range. *Audio*
Frequency response is exceptionally flat. *High Fidelity*

Tracking This is the only cartridge we have seen that is really capable of tracking almost all stereo discs at 0.4 grams. *Stereo Review*
The XLM went through the usual torture test at 0.4 grams (some top models require more than a gram). *High Fidelity*
The XLM is capable of reproducing anything found on a phonograph record. *Audio*

Distortion Distortion readings...are without exception better than those for any other model we've tested. *High Fidelity*
The XLM has remarkably low distortion in comparison with others. *Audio*
At 0.6 grams the distortion was low (under 1.5 per cent). *Stereo Review*

Hum and noise The XLM could be instrumental in lowering the input noise from the first stage of a modern transistor amplifier. *Audio*
The cartridge had very good shielding against induced hum. *Stereo Review*

Price This would be a very hard cartridge to surpass at any price. *Stereo Review*
We found it impossible to attribute superior sound to costlier competing models. *High Fidelity*
Priced as it is, it is a real bargain in cartridges. *Audio*

SOLE AUSTRALIAN REPRESENTATIVES:

J. H. REPRODUCERS CO.

Reg. Office: 293 HUNTINGDALE ROAD, CHADSTONE, VIC. 3148, AUSTRALIA
Telephone: 277 3066, 277 3488

take most of the current, while the highest resistance will take least current, and so on.

Because of this fact, a moving-coil meter may be arranged to measure large currents. Its coil has a certain value of resistance and, by placing in parallel with it a smaller resistance called a "shunt," the meter coil will receive only a known minor part of the current.

A typical meter movment giving full-scale deflection of the pointer needle with only 1 milliamp through its coil can thus be arranged to read as a 1 amp meter, by wiring it in parallel with a shunt which takes 999 / 1000ths of the current flowing through the two. The shunt would simply have a resistance of 1 / 999 that of the meter coil so that, when 1 amp flows through the two, the shunt takes 999 milliamps and the meter receives its correct 1 milliamp.

If the total current should be less than 1 amp, the meter will read the same proportion of 1 milliamp. Thus ½-amp of total current would read half-scale on the meter.

When we discussed Ohm's Law we also saw that, when a voltage is applied to a resistance, a current flows which is proportional to the applied voltage and inversely proportional to the resistance. It is this fact which permits us to use the moving-coil meter to measure voltage.

All we have to do is connect the meter coil in the series with a resistor, which is called the "multiplier." The multiplier is made to have a resistance which, when added to that of the meter coil, will draw the full-scale meter current when the intended full-scale voltage is applied to the two.

An example should again make this clear: Suppose we have a 1-milliamp meter and we want to use it to read from 0 to 100 volts. All we need do is work out from Ohm's Law the resistance which draws 1 milliamp when 100 volts is applied, which works out to be 100k (100 divided by 1 / 1000, giving 100,000). To find the multiplier resistor value, we simply subtract the resistance of the meter coil from this figure. Thus, if the meter coil has a resistance of 100 ohms (a typical figure) we will need a multiplier of 99,900 ohms in series with the meter to convert it into a 0-100 voltmeter.

In practice, if subtracting the meter resistance only affects the multiplier resistor value by the small amount shown above, it would be neglected. An accurate 100k resistor would be quite close enough as the multiplier.

In these circumstances, 100 volts applied to the combination would make the meter read full scale. With 50 volts applied it would read half-scale and with 25 volts, quarter-scale. By marking the meter scale in volts to 100, any voltage up to 100 can be read directly.

Different voltage ranges may be provided simply by selecting different values of multiplier resistance.

There are a number of different arrangements whereby the moving-coil meter may be used to measure resistance. The resistance-measuring circuit most often used is basically little more than a battery wired in series with the meter.

When an unknown resistance is connected into the circuit between the appropriate terminals, it completes the circuit and a current flows through the meter. The amount of current (and hence the meter reading) will depend upon the value of the resistance. Small resistors will produce a large current, and large resistors a small current; thus the scale of the meter can be marked in terms of resistance.

The moving-coil meter may also be used to measure AC, with the aid of a small rectifier circuit to change the AC into DC. Multiplier resistors may be added to the meter-rectifier combination to measure alternating voltage, while a small transformer is used to allow the combination to be used to measure heavy alternating currents.

The common "multimeter" or "VOM" (short for Volt-Ohm-Milliameter) is simply a meter movement fitted into a case along with a variety of current shunts, multiplier resistors and resistance measuring circuits, to enable it to be used to perfom a wide variety of measuring tasks.

It is usually provided with switches to select the various shunts or multipliers, etc. Alternatively it may have a series of pin-jacks or terminals to which the test leads may be connected by the user, depending on the measuring job to hand.

The multimeter is one of the most useful instruments in electronics. A modern instrument of the type shown in the photograph may provide thirty or more different measuring ranges, covering voltages (AC and DC) from a fraction of a volt to many thousands of volts; currents from microamps to amps; resistance from a fraction of an ohm to many megohms. It may also provide built-in protection for the meter, to guard against damage due to improper setting of the controls.

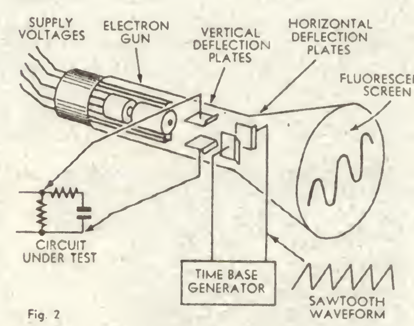


Fig. 2: (above) Basic operation of the CRO or "scope". At right is a typical small instrument of this type.

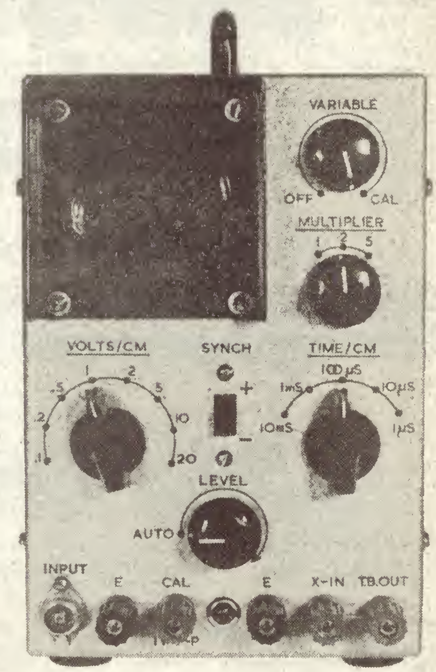
Because the moving-coil meter is essentially a current reading device, the multimeter always draws a small current when being used to measure voltage. With modern, sensitive meter movements this metering current may be as low as 10 or 20 microamps for full-scale deflection, but even this current can load some circuits unduly and produce reading errors.

It was principally because of the loading imposed by the moving-coil multimeter that electronic voltmeters and multimeters were developed. These use either valves, bipolar transistors or FETs to increase the sensitivity of the basic moving-coil meter, at the same time giving it a very high effective input resistance so that it does not seriously load even high resistance circuits being tested. Typically the input resistance of an electronic voltmeter is around 10 megohms, while special types may go as high as several hundred megohms.

The first type of electronic voltmeter to be developed was the vacuum-tube voltmeter or "VTVM", also called the valve voltmeter. This generally used two triode valves, or a twin triode, in a balanced circuit. Electronic voltmeters and multimeters using valves are still available, but most modern instruments of this type use either bipolar transistors or FETs, and thus go under the name of solid-state voltmeter or "SSVM".

The principal disadvantage of VTVMs and other electronic meters using valves is that considerable power is needed to run the valves, so that they must generally be operated from the AC mains. This limits their versatility compared with a simple moving-coil multimeter. Solid state voltmeters are less subject to this limitation, however, as they can operate for quite long periods on a small battery supply. Modern SSVMs are in fact fast becoming used for many of the jobs formerly handled by the multimeter, because of their higher input resistance.

Multimeters and electronic voltmeters permit the measurement of voltages, currents and resistances in circuits, but they do not allow us to see the ways in which



currents or voltages may be changing — unless the changes are taking place very slowly. The cathode-ray oscilloscope or CRO, also called the "scope", is an instrument which allows both fast and slow changes to be seen. It may also be arranged to measure voltages and frequencies.

The heart of the CRO is the cathode-ray tube, which is a small-scale version of the picture tube used in television receivers. In addition to the size difference, the cathode-ray tube used in most oscilloscopes uses what is termed electrostatic deflection, rather than the magnetic deflection used by television picture tubes, and has no "yoke" mounted on its neck.

Fig 2 should help in understanding how the cathode-ray oscilloscope works. The tube consists of three main parts — a group of electrodes called the "electron gun," two pairs of flat electrodes called the deflection plates, and a fluorescent screen.

It is the screen which is visible at the front

of the ocilloscope, and it is on the screen that a "picture" of circuit voltage or current changes appears. Repeating changes, like those of alternating voltages and currents, produce fixed wave-like patterns on the screen — hence the use of the term "waveform" to describe the screen patterns and the circuit variations which they represent.

The purpose of the electron gun is to produce a fine stream of electrons aimed at the flurorescent screen. The gun has a heated cathode similar to that in a normal valve, and a system of cylindrical and disc electrodes used to control and guide the electrons into a narrow beam.

If the deflection plates were not there, or if they were not connected to anything, the electron beam from the gun would strike the centre of the fluorescent screen and cause the phosphor powder at that spot to glow. All that would be visible would be a small bright dot at the centre of the screen.

Consider what happens to the beam when one of the pairs of plates — say the pair marked "vertical deflection" — is connected into a circuit so that a changing circuit voltage appears across the two plates.

The two deflection plates are in effect a parallel-plate capacitor, and the voltage difference between them will set up an electric field in the space between them — through which the electron beam is travelling. As the voltage of the circuit varies, the electron beam will therefore find itself in a varying electric field.

Electrons, it will be recalled, are negatively charged, and the electrons of the beam will thus tend to be moved or "deflected" by the electric field toward the more positive plate. The beam is travelling quite fast, so the electrons will not actually be able to reach the more positive plate, but the beam will be bent in the direction of the plate and the electrons will hit the fluorescent screen at a new spot somewhat removed from the centre of the screen. The exact distance moved will depend upon the voltage applied to the two plates.

As the voltage of the circuit varies, the bending of the beam will also vary and the glowing spot on the screen will move up and down in sympathy. Whenever the top plate is more positive than the lower plate, the beam will bend upward and the spot will move up. Conversely, when the lower plate is more positive than the upper plate, the beam will be deflected downward and the spot will move below the centre of the screen.

The amount of beam deflection produced at any instant will be proportional to the circuit voltage present at that instant, and so the distance moved by the spot on the screen will be directly proportional to the circuit voltage at all times. If too much voltage is applied to the plates, the beam will be deflected right into the glass neck of the tube, and the spot will disappear off the top or bottom of the screen.

So far, the cathode-ray tube is simply acting like a meter with an electron-beam indicator "needle". But here is where the second set of plates come in — those marked "horizontal deflection." These are very similar to the first set, but are closer to the screen (for mainly physical reasons) and are turned sideways so that any voltages applied to them will tend to move the beam and spot horizontally.

A circuit called the "timebase generator" applies to this second set of plates a voltage which changes linearly (smoothly) for a certain period then drops back to its initial value, then changes linearly again, and so on. The waveform of this voltage is thus shaped like the teeth of a rip-saw, and is accordingly called a sawtooth sweeping voltage.

The effect of this sweeping voltage is to move the beam and spot smoothly across the screen from one side to the other, then quickly back again, then smoothly across again, and so on. The speed at which this occurs can be adjusted over a wide range by controls in the timebase generator circuit.

By this horizontal movement of the beam and spot, the timebase waveform "spreads out" the up-and-down spot motion produced by the signal so that it can be seen.

In effect, the cathode-ray tube plots a graph of the test voltage compared with time; the time represented by one sweep of the time base waveform can be worked out or measured.

The cathode-ray oscilloscope thus allows us not only to see the circuit voltages changing, but to measure by how much they change — given by the height of the pattern — and how long they take in changing — which may be deduced from a knowledge of the period of time represented by one sweep of the timebase waveform. It is thus an extremely useful instrument.

Most modern oscilloscopes include an amplifier (called the "Y" or "vertical" amplifier) to enable very small circuit voltages to be made large enough to produce a visible deflection of the spot. The amplifier has a switch to allow the selection of various amounts of amplification, and the switch is marked directly in terms of the amount of input voltage which is represented by 1 centimetre of vertical spot deflection. Voltages can thus be measured quite easily.

The speed of the timebase generator is adjustable by means of other switches, and these again are marked directly in terms of the period of time (in seconds, milliseconds or microseconds) represented by 1 centimetre of screen width. Time duration and frequency can thus also be measured quite easily.

In passing, it should be noted that some oscilloscopes, notably the older types and the simpler modern types, do not have such "calibrated" vertical amplifier and timebase controls. They often have just a variable gain control on the vertical amplifier and have timebase controls either unmarked or marked in terms of the approximate timebase sweeping frequency (in Hertz). Such instruments are intended mainly for "looking" at circuit goings-on, and are not really suitable for making measurements.

Most oscilloscopes have knobs to control the brightness and focus of the spot, and to set the spot to the centre of the screen when voltages having a large steady component are being measured. These latter are called the "shift" or "centering" controls.

Oscilloscopes are also fitted with circuits to enable the timebase to be locked or "synchronised" with the voltage under inspection so that the screen pattern is held steady. Depending upon the exact type of circuit used, the controls associated with this feature may be marked "synch." or "triggering" or "locking" adjustments.

In some of the preceding chapters, we have referred to sources of RF alternating voltage, called variously modulated RF oscillators or RF signal generators depending upon their degree of refinement. It was explained that such devices are basically valve or transistor type oscillators, provided with a tuning capacitor and various coils to set the desired frequency band.

They usually include provision for modulating the RF voltage with a fixed audio tone (usually 400 or 1,000 Hz), and with a reliable control over the amount of output voltage delivered — the so-called "attenuator."

In laboratory parlance, the name "Signal Generator" is usually reserved for instruments which have a meter to monitor the output voltage and the degree of modulation present, and an output voltage attenuator capable of setting the output to a known level between a fraction of a microvolt and a few volts.

Just as there is a need for instruments able to supply RF voltage, there is a similar need for instruments able to supply low- and

An audio signal generator of modern design, using solid-state circuitry.

audio-frequency alternating voltages. Such instruments are known as audio oscillators or audio generators, the latter being the counterpart of the RF signal generator in terms of accuracy and refinement.

One early type of audio oscillator was the so-called "beat frequency oscillator" or "BFO", so named because it generated the desired audio signal by beating together two RF signals. This type is now rarely used because it tended to have poor frequency stability and a rather high distortion level. Most modern instruments are based on oscillators which generate the audio signal directly, a common type being based on the so-called "Wien bridge" network. This consists of a network of resistors and capacitors connected in a feedback loop around a high-gain audio amplifier.

Modern instruments of this type can typically deliver audio signals from as low as 1Hz to above 200kHz, at levels from a fraction of a millivolt to many tens of volts. The output waveform may be either a sinewave, with perhaps a distortion level as low as .01%, or other waveforms such as square wave or triangular wave.

There are many occasions when resistors, capacitors and inductors must be accurately measured to determine their value of resistance or reactance. While a reasonably accurate measurement can be made using various circuits provided on a multimeter or electronic multimeter, it is usually necessary to employ what is known as a measuring bridge in order to make really accurate measurements.

Basically, a measuring bridge is a device which balances the unknown resistor, capacitor or inductor against a known or standard unit, to give an indication of the relative value of the unknown component. This type of measurement is accurate because the bridge simply performs a comparison between the unknown unit and a highly accurate standard unit; it does not rely upon the voltage of an internal battery or oscillator, or the accuracy of a meter. If a meter is used in the bridge, it is simply used as a balance indicator and not used as a measuring device.

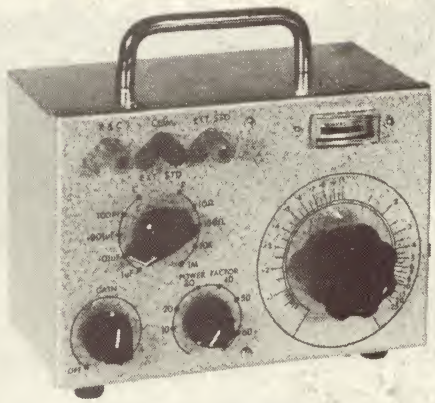
For the measurement of inductance a rather elaborate bridge is required, whereas quite a simple bridge can measure resistance and capacitance fairly accurately. For this reason most of the simpler measuring bridges are called R-C bridges to signify that they are really only suitable for measuring resistance and capacitance.

The R-C bridge shown in the photograph has inbuilt standard resistors and capacitors for six comparison ranges, with a pair of terminals provided so that additional standard resistors or capacitors may be connected if desired. The comparison is carried out at a frequency of 50Hz and a small meter used to indicate when a balance is achieved. On older bridges this function was served by a special valve known as a "magic eye" or electron-ray indicator which indicated balance by means of two overlapping fan-shaped glowing segments on a fluorescent screen.

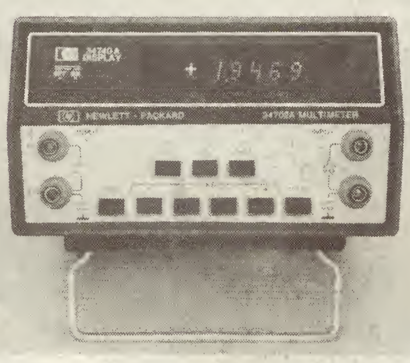
The bridge is adjusted for a balance by means of the large dial knob, which effectively "tries out" various ratios between the unknown and standard components. When it finds the ratio which produces a balance, the dial reading gives the value of the unknown component relative to the standard. If it reads "0.5" when the standard is 100pF, for instance, the unknown capacitance is 50pF. If it reads "3.4" with the same standard, the unknown would be 340pF.

The instruments which we have looked at so far are perhaps the most common types which are met in electronics. Before we leave this topic, however, it might be worthwhile briefly mentioning a few of the many not-so-common instruments.

The sweep and marker generator is an instrument used in the alignment of TV receivers and similar applications. It is in effect two RF oscillators or signal generators in one. The sweep section generates an RF signal which is swept back and forth in frequency, and may be used in conjunction with a CRO to show how tuned circuits and amplifiers behave over the band of frequencies being swept. The marker is a fairly normal RF oscillator used to identify or "mark" the various frequencies being swept through.



A typical small R-C measuring bridge. The value of an unknown component is read on the large dial.



A modern digital multimeter made by Hewlett-Packard. Readout is by light-emitting idodes or LEDs.

Valve testers and transistor testers are intruments used to check valves and transistors for proper operation. Simple types may only indicate the difference between useless or very poor units and those which should operate more or less normally. The more elaborate instruments place the valve or transistor being tested under its correct operating conditions and measure just how well it performs.

Distortion meters are audio testing instruments which may measure one or more of a number of different types of signal distortion. They are often combined in the one case with an instrument called a millivoltmeter — which, as the name suggests, measures very small alternating voltages. The millivoltmeter is very useful for measuring the performance of microphones and gramophone pick-ups, as it can measure their output voltage directly.

Dip oscillators are small RF oscillators which have externally-mounted resonance coils and a meter which indicates their strength of oscillation. They are used to determine the tuning frequency of resonant circuits in receivers and other equipment. When the coil of the dip oscillator is brought near the coil of the unknown tuned circuit, the frequency is varied until the meter indicates that the test circuit is absorbing some of the oscillation energy — this shows as a "dip" in the meter reading. The dip oscillator dial then indicates the resonant frequency of the unknown circuit.

The first dip oscillators used valves, and were called "grid-dip oscillators" or "GDOs" because the strength of oscillation was monitored by measuring the oscillator valve's grid current. Nowadays most dip oscillators use either a bipolar transistor or a FET in the oscillator, resulting in a smaller and more flexible instrument.

The signal tracer is effectively a sensitive radio receiver fitted with a switch which permits signals to be fed into it at any of the various points along the signal path. It is used to follow the path of radio signals through a receiver under test, in order to find out speedily the section of the receiver which is faulty.

Digital counters or digital frequency meters (DFMs) are instruments used to measure frequencies and time periods, and to count pulses. They operate by converting the input signals into a stream of rectangular pulses, and counting the number of these pulses occurring in a known period of time. The counting is performed by groups of circuit modules known as "flip-flops", which are bi-stable circuits capable of flipping from one stable state to the other when triggered by a pulse. Readout of the count is in the form of glowing numbers, usually from either special gas discharge tubes or from arrays of light-emitting semiconductor diodes or "LEDs".

Digital voltmeters or "DVMs" are electronic voltmeters which, like digital counters, operate by counting rectangular pulses and displaying their reading in the form of glowing numbers. However in a DVM an input circuit is used to produce a group of pulses whose number is directly proportional to input voltage, so that when they are counted the reading may be arranged to indicate the input voltage. The voltage-to-pulses conversion is generally performed by a circuit which generates a voltage "ramp" which is linearly rising or falling from zero or a set value, and opens a digital "gate" to pass the pulses until the ramp voltage just equals the voltage to be measured.

Although we may seem to have looked at quite a number of test and measuring instruments in this chapter, there are a great many more that we have not been able to mention. All sorts of test and measuring instruments have been developed in order to make the job of the electronics worker a little easier, faster and surer.


Zero 100:
the most sophisticated turntable in the world.
Garrard
Garrard

Nice work if you can afford it.

but for smaller budgets here are some other models from the same stable

Model SL95B

Model SP25 Mk III

Model 2025TC

Model SL72B

Model AP76

Model SL65B

Model 60B

Model 40B

Zero 100:

The Zero 100 is the newest model number to bear the proudest name in high fidelity record playing equipment. Garrard's reputation has been re-earned year after year for over half a century by pedigree performance. Now, once again, Garrard lives up to its reputation with an automatic unit advanced beyond any others now available in performance and convenience. This brilliant new star features zero degree tracking error together with twelve other major advances. Now, more than ever before, there's a Garrard turntable for every component music system.

Garrard

Plessey Ducon Pty. Limited
Villawood, N.S.W., 2163.

For further information contact National Distributors:

British Merchandising Pty. Ltd.
New South Wales.
49 York Street, Sydney

Audioson International Pty. Ltd.
Western Australia:
196 Adelaide Terrace, Perth
Queensland:
72 Wickham Street, Valley, Brisbane
South Australia:
9 Osmond Terrace, Norwood, Adelaide
Victoria:
49 Westbank Terrace, Richmond, Melbourne

RAD42

Multivibrators . . .

Basic Building Blocks

Elementary Electronics

by ROSS TESTER

The multivibrator, in one or other of its forms, is very much an integral building block in electronics. We aim to show you the various types, how they work, and some of the ways in which they are used.

There are three basic types of multivibrators. These are the astable (also known as the free-running), the monostable (also known as the one-shot) and the bistable, (also known as the flip-flop).

We will deal with each of these in turn. First, the astable. This is the most common type of multivibrator encountered in everyday electronics. As its second name suggests, it requires no stimulus or trigger pulse to start it, but keeps operating for as long as power is applied.

If a trigger pulse is provided, it can trigger the multivibrator before it would have triggered normally. This is useful in many applications where synchonisation or frequency division is necessary, but we will have more to say on this later.

The second type is the monostable, or one shot. The latter term is an apt description of its operation, for it gives one pulse out whenever it is triggered. It has only one stable state, which it reverts to immediately after being triggered.

The third type is the bistable. This is one of the basic parts for all computers and calculators. As its name suggests, it has two stable states. It remains in either state until a stimulus or trigger pulse is fed into it to change it to the opposite state. On the arrival of a second pulse, it reverts to its original state, and so on.

From figures 1, 2 and 3 it is obvious that all three types are similar. Both have two transistors, interconnected so that when one of the transistors is cut off, the other is saturated, or hard on. The difference is in the way they are interconnected.

The astable is purely AC coupled, because it is interconnected by capacitors only. If you have followed our Home Study Course, you will know that a capacitor blocks DC, but allows AC to pass.

The monostable is a mixture — one side of the circuit is both AC and DC coupled (via a resistor) and the other half is AC coupled only (via a capacitor). The bistable is AC and DC coupled on both sides, because resistors have replaced both capacitors.

Refer to figure 1. This is the circuit of a basic astable multivibrator. Two transistors are so connected, that when one is conducting, the other is not. This may seem a little strange, but it will be better understood if we explain what happens.

When power is first applied, one of the transistors will conduct harder than its partner, because of component tolerances (transistors with different gain, capacitors with different values, etc). It is virtually impossible to find two transistors which will both conduct by the same amount.

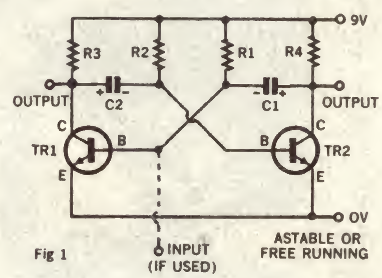


Fig 1

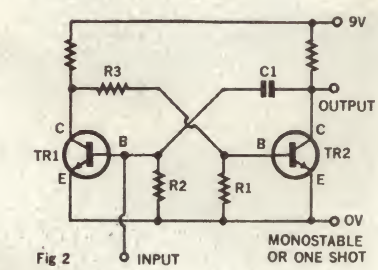


Fig 2

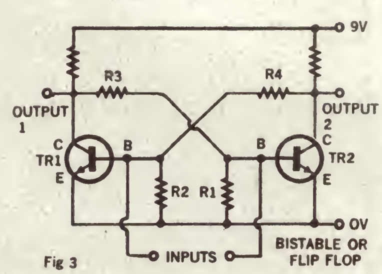


Fig 3

The three basic forms of multivibrator. While broadly similar, the differences are important, as discussed in the text.

Say, for example, it is TR1 which conducts hardest initially. Its collector voltage would drop to nearly zero volts (there is a small voltage across the transistor). Capacitor C2, which would have charged to the polarities shown almost immediately on switch-on, would now find its positive plate connected (via TR1) to the negative rail. There is nine volts potential difference between the positive and negative plates so it would, effectively, place a minus nine volts potential on the base, relative to the emitter, of TR2. This reverse biases TR2 and turns it off.

When TR2 is turned off, its collector voltage rises sharply to the positive supply voltage, and therefore commences to charge C1. The charging current for C1 flows through the base-emitter junction of Tr1 as forward bias, and therefore holds it on. This capacitor charges relatively quickly, as the resistance to its charging current is quite low. When the charging current falls to a level which would not normally hold the transistor on, the bias resistor R1 takes over this role and holds it on. It remains in this state until capacitor C2 has fully discharged, and the reverse bias is removed from TR2.

When this reverse bias ceases, TR2 is turned on by the bias resistor R2. Immediately this happens, the collector voltage drops to near zero. Because the positive end of capacitor C1 is now virtually connected to the negative rail, TR1's base (which is connected to the negative end of C1) is effectively at minus nine volts with respect to the emitter. This reverse biases TR1, and turns it off.

This begins the charge and discharge cycle once again, until the original state is reached (TR1 on, TR2 off). Then, the cycle repeats again, and again, and again . . .

This is the reason this type of multivibrator is known as the astable or free running. It has no stable state — it keeps on jumping backwards and forwards for as long as power is applied.

The waveform generated by an astable multivibrator is rectangular, though it is commonly, and sometimes erroneously, called a "square wave". If the two halves of multivibrator are perfectly balanced, the pulses from each half will be equal in length. This is normally referred to as a square wave. If the two halves are not balanced, perhaps deliberately, then the pulses will be of unequal length and the waveform is more correctly referred to as rectangular.

The values of R & C can be adjusted to give the required frequency of operation —

R1 & C1, or R2 & C2 will effect this. The amplitude of the output pulse, which may be taken from either transistor, is mainly dependent on the supply voltage.

As we said before, the monostable or one-shot has one of its capacitors replaced by a resistor. Referring to figure two, we can see that TR1 is provided with an input to its base, and TR2 with an output from its collector.

With the input terminal at OV TR1 is cut off, and its collector is at 9V with respect to the negative supply. TR2, therefore, receives heavy forward bias, and is driven into saturation. Its collector, and therefore the output, is at near zero volts. Capacitor C1 is essentially uncharged.

If the input is momentarily raised to a positive voltage level current flows through the TR1 base-emitter junction, forward biases it and turns it on. Its collector voltage falls to near zero and the forward bias is removed from TR2, which cuts off. This raises its collector (and the output) to +9V. Once this set of conditions prevails, the initating pulse is no longer required. It may be removed without having any immediate effect on the state of the circuit.

Capacitor C1 is now effectively connected to the positive supply rail via R4 and to the negative rail via the base emitter junction of TR1 and R2 in parallel. It therefore commences to charge. Because the base-emitter junction constitutes a low resistance path relative to R2 most of the charging current flows through this junction in the form of forward bias. Thus TR1 is held in the "on" state until C1 is almost fully charged, that is, until the charging current falls below the minimum bias saturation level.

When TR1 is deprived of forward bias it can no longer conduct, the voltage on its collector rises to the +9V rail level, TR2 is biased on, and the circuit reverts to its original state. It will remain locked in this state until another pulse is applied to the input terminal.

If the input pulse had not ended before the capacitor had ceased charging, the monostable would not revert to its normal state. Rather, it would remain triggered until the input pulse stopped, whereupon it would change back almost immediately.

In this case, the monostable would not stretch the pulse length as it does in the case where a short input pulse is applied; rather it would merely square up the corners of the pulse and increase the amplitude.

A typical use for the monostable would be in television relay systems, where the synchronising pulses may be degraded after transmission via a microwave or satellite link. The degraded incoming pulse can be used to trigger a monostable which will generate a new, correctly shaped pulse.

The third type of multivibrator, shown in figure 3, is, in its simplest form, also known as a flip-flop. When power is applied to the flip-flop, one of the two transistors will saturate, forcing the other to cut off. If TR1 is turned on, TR2 will be cut off, and its collector (and output 1) will be at +9V.

If we apply a positive voltage pulse to the base of TR2, it saturates, and the collector voltage drops to near zero. This removes the forward bias from TR1, and cuts it off. Therefore, its collector (output 2) increases to 9V. Then, if we shift the input pulse back to TR1 once again, the reverse happens, and the circuit reverts to its original state.

Applying a positive pulse to the transistor which is switched off is not the only way we can trigger the flip-flop. An alternative is to apply a negative pulse to the transistor which is switched on, thereby switching it off. A variation on this theme is to simply connect the base of the switched on transistor momentarily to its emitter, again switching it off.

Figure 3 shows two inputs and the triggering pulse must be directed to whichever input is appropriate to the circuit's state at

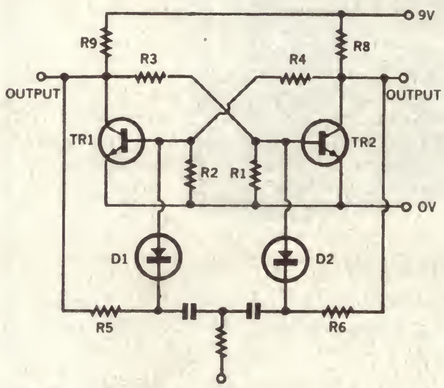


Fig 4

Simplified T or Gated R-S flip flop. The diodes steer the incoming pulses according to which transistor is "on".

that time, in order to trigger it into the opposite state. Sometimes, when the pulses are derived from separate sources, this is quite convenient. When they come from the same source it is obviously not convenient to physically change the connection from one input to another.

If the pulse is simply applied to both transistor bases without a gate to steer it to the correct place, the flip-flop will not toggle as it should. If the pulse is negative, it will certainly turn off the conducting transistor, but it will also hold off the non-conducting transistor until the pulse ends.

When the pulse ends, both transistors turn on and a race is established to see which can force its partner to turn off. The result is completely unpredictable. Naturally, the converse is true with a positive pulse. Such a situation is obviously undesirable.

For this reason, flip-flop circuits have been developed which automatically direct the pulse to the appropriate input. These are known as the Gated R-S and the J-K flip-flops.

A simplified form of such a circuit is shown in figure 4, and its operation is easily understood. The main additions to the circuit are the diodes D1, D2 and the biasing resistors R5, R6.. Let us suppose that TR1 is saturated and TR2 cut off. In these circumstances the cathode of D1 will be connected to the negative rail, via R5 and TR1, while the anode will be connected to the positive rail via R4 and R8. Thus the diode will be heavily forward biased and will pass current readily in either direction.

At the same time, D2 has its cathode connected to the positive rail via R6 and R8, and its anode to the negative rail via R3 and TR1. It is therefore heavily reversed biased, and will not pass current in either direction.

If we now apply a negative pulse to the input terminal this will be directed to the base of TR1. The effect will be to cut TR1 off and, in the manner we have already explained, bias TR2 on. At the same time the conditions pertaining to D1 and D2 are reversed; D1 is now reverse biased and D2 forward biased. Thus, the next negative pulse which arrives will be directed to the base of TR2, which will then be cut off.

In this way alternate pulses are directed to opposite sides of the circuit, switching it back and forth from one state to the other. An interesting sidelight on the circuit's behaviour, which can be readily understood at this point, is that it gives out one pulse for every two pulses in, and thus functions as an extremely reliable two-to-one frequency divider. It is used extensively in this role in computer circuits, forming the basis of binary counting.

Earlier, we mentioned the ability of a multivibrator to be locked by synchronising pulses. This ability can be used to perform frequency division. Theoretically, quite large orders of division are possible, but they are seldom used to perform more than a divide-by-ten function, as the reliability of the system becomes poor above this figure. Normally, a divide-by-five multivibrator would be preferred.

Figure 5 shows the way frequency division occurs. It shows the voltage waveform at the base of the non-conducting transistor. The initial pulse, for our purposes, can be disregarded as it is the one which previously flipped the multivibrator over. The first and second pulse after this would have no effect, as they would arrive while the transistor is conducting anyway.

The third pulse would arrive while the transistor was cut off, and it would be added to the negative voltage to make it less negative. However, this would not have any effect, as the transistor is still heavily reverse biased and the combined voltages (that of the pulse and the capacitor) would still be much less than zero. Similarly for the fourth pulse. It would come closer to making the sum of voltages zero, but would just miss out.

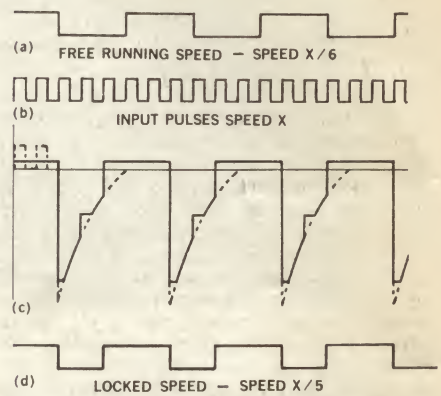


Fig 5. Frequency division. Diagram (c) shows the input pulses added to the negative base voltage to force the transistor to conduct early.

The fifth pulse arrives when the capacitor is very nearly discharged. In other words, the multivibrator is nearly at the point where it would flip over of its own accord. However, the pulse makes it do this early. The sum of the voltages is either zero, or slightly positive, so the transistor can be turned on by its bias resistor. Therefore, the period of the pulse given by this multivibrator is equal to that of five pulses in — or a five-to-one division.

The reason the system becomes unreliable at higher divisions should now be obvious. With so many pulses arriving during the cycle, there is a risk of the multivibrator triggering early on the wrong pulse — particularly if the amplitude of the pulse is a little higher than it should be. Or it may trigger late — if the amplitude of the correct pulse is not enough. Therefore, the amplitude and the pulse width must be substantially constant if this method of frequency division is to be successful.

A variation on this theme involves locking the multivibrator to synchronising pulses, without involving frequency division, ie, the multivibrator operates at the same frequency as the pulses. All that is

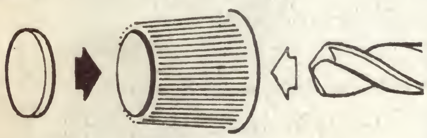
(Continued opposite)

Elementary Electronics Ideas Worth Trying

Inexpensive Knob

Anyone who has constructed anything with a large number of potentiometers on it will know that the control knobs are a major factor in determining panel size. Finding suitable knobs can sometimes be a problem. I recently had this trouble, having completed a project only to find that very small knobs were not available.

I realised I would have to innovate. I finally settled on toothpaste tube tops as pot knobs. Not only were they the right size, but came in a variety of colours. They needed only a small modification. This was done with a ¼in twist drill. The elastic quality of the plastic will allow it to expand as the drill goes through, so when the drill is withdrawn the hole will contract to slightly less than ¼in, making it a snug force fit on a ¼in pot shaft.



All that remains is to insert a small cardboard disc in the front and the job is finished. These home made pot knobs not only look the part, but they have good insulating qualities, are easy to fit, give torque overload protection and come free with every tube of toothpaste.

The only disadvantage is a somewhat cranky wife or mother when the toothpaste oozes out onto the bathroom shelf. (From Mr M. Cuffe, 48 Market Street, Naremburn, NSW.)

Editorial comment: One of our staff members hit on this idea quite independently. To fill the end of the cap he used a small brass washer, with the hole in the washer filled with solder and sanded flat on the outer side. Finish was with black wrinkle lacquer from an aerosol can and the finished product is fully professional in appearance. The main advantage as far as this case was concerned was that the knob was smaller than those normally available, and allowed an extra control to be fitted to an already rather crowded control panel.

Printed Wiring

Here is a useful hint concerning printed wiring boards. Normally, a protective paint is used to define the pattern, but I have found it difficult to get straight, thin lines using this method. I now use what I think is a better method.

First the board is cleaned. One way is to use steel wool. Then a sheet of adhesive plastic is pressed onto it. This must be large enough to cover the whole board. The plastic is normally available at stationery or hardware stores and the type I use is sold under the name "Contact."

The required pattern is copied onto the plastic using a felt pen, carbon paper, or whatever is available. Cut along these lines using a single edge razor blade or sharp knife.

The plastic covering the copper which needs to be etched can now be removed. The plastic which remains must be pressed down firmly to ensure there are no air bubbles and that it has not moved out of place.

The board is etched in the usual way and the etchant will work faster if it is warmed during etching.

(From Mr T. Van Slageran, North Geelong, Victoria)

Soldering Hint

I have found it very difficult soldering transistors and small diodes salvaged from printed circuit boards. Usually the leads are so short that damage by the hot solder is almost inevitable.

I have solved this by applying a drop of water, either with the end of the finger or from a wet cotton bud, immediately after soldering. This quickly cools the lead and joint to a safe temperature. This has enabled me to re-use small solid state devices over and over, without damage.

(From Mr B. Jones, Towong, Victoria.)

Editorial comment: A variation on this idea might be useful in some cases. Where there may be a risk of damage to other components by using water, methylated spirit may be substituted. This also has the advantage of providing better cooling by reason of its rapid evaporation.

Awkward Nut

How often do you spend half an hour trying to get a nut into an inaccessible corner? It is quite easy when you know how. Simply tap the end of a length of solder into the thread of the nut, bend the solder to suit, then twist the whole assembly until the thread of the nut grips the screw. Complete the job by griping the nut with long nose pliers.

(From Mr B. Pettingill, Warrnambool, Victoria.)

Multivibrators . . . Cont.

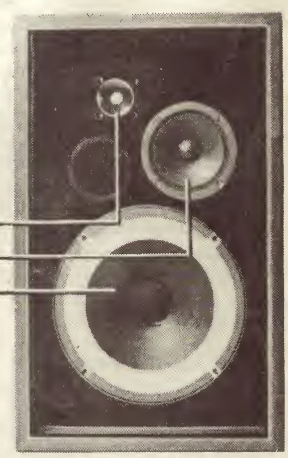
necessary in this case is for the free running frequency of the multivibrator to be slightly slower than the pulse frequency. Each pulse then triggers the multivibrator earlier than it would have switched naturally.

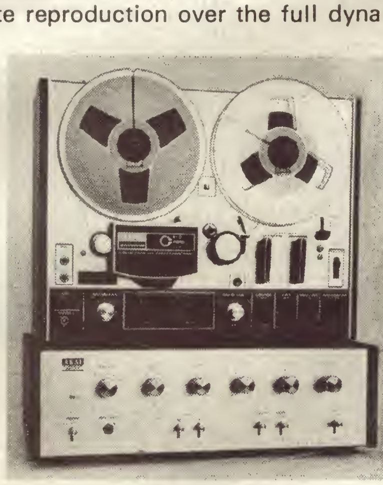
A typical application for this arrangement would be in some of the simpler types of TV synchronising circuits. The horizontal and vertical synchronising pulses which form part of the transmitted TV signal are separated from the video signal, and from each other, and may then be used to trigger multivibrators running slightly slower than the sync pulse frequency. For example, the vertical sync pulses occur at 50Hz, so a multivibrator normally running at 47 or 48Hz would lock in and run at 50Hz.

This ends our theoretical discussion on the basic types of multivibrators. Next month, we will present some practical circuits which will put the various types of multivibrators to work for you.

Akai SW-125 . . . The world's first speaker with "linear travel piston"*

"L.T.P."—another first in the long line of Akai achievements for better listening. Akai SW-125 features a highly advanced 3-way, 3-speaker system. The handsome oiled wood cabinet finish gives the complete Hi-Fi system an appearance of incomparable elegance and houses an "L.T.P." system comprising a 10" woofer with specially treated cone, a 5" mid-range and 2" horn type tweeter, to give the ultimate reproduction over the full dynamic range.





The Akai Matched Stereo System

- 4000DS Tape Deck with one micron head (OMH)
- AA5200 Sep 60 Watt Amplifier with AB output.
- SW-125 Loudspeakers with LTP

Hear them now at your nearest Hi-Fi stockist.
Distributed by:—
AKAI AUSTRALIA PTY. LTD.,
276 Castlereagh Street,
Sydney. Phone 61-9881.

AKAI

AK.22

CLASSICAL RECORDINGS

Reviewed by Julian Russell

Mahler Fifth — "should provide endless pleasure"

MAHLER — Symphony No 5 in C Sharp Minor. Adagio from Symphony No 10 in F Sharp Major. Concertgebouw Orchestra conducted by Bernard Haitink. Philips Stereo 6700 048.

Mahler's Fifth Symphony is formally very complex despite its apparent simplicity. It falls roughly into three main sections further divided into five movements, all laid out around the most important movement of the symphony, the Scherzo. This is a movement of tremendous vitality despite its Mahlerian reliance on central European peasant dance tunes usually in the form of landlers, some, alas, banal but all treated in a manner that demands respect. Some of them are transformed into Viennese-type waltzes, others are made to bear the burden of the composer's bitter irony. A scherzo originally meant a joke, but there is nothing frivolous in this movement which is a long statement of considerable profundity. Lack of space prevents me from setting out the formal complexities of this movement alone, yet it will be only an occasional reader who might find it without appeal.

The Adagietto was the first of Mahler's music to win popularity with the general run of Anglo-Saxon music lovers when it appeared on 78s between the two wars — or it might even have been earlier. Taken, as it was then, out of its context, it seemed to be just a piece of cloying sentimentality. In its context, as you will hear it here, it supplies a welcome point of repose. Haitink avoids sentimentalising it, yet does so at no sacrifice of warmth. It is scored for strings and harp only; the result is music of heavenly peace. One might well have expected a longer slow movement to balance the rest of the symphony but this shortish adagietto sounds quite miraculously right and leads without a pause into a rollicking rondo finale made up of brief jolly themes, eccentric ones all interrupted by much polyphony — fugues, double fugues and endless technical ingenuities.

This Fifth is perhaps the most Mahlerian of all the symphonies, not only in its unique sound but in its shape too, which at first seems appallingly untidy but after study discloses its inspired symmetry. I enjoyed the playing of the Concertgebouw under Haitink enormously. The sound is excellently engineered and the orchestra follows the lightning-like changes of mood with envy-provoking ease.

The symphony is on three sides of two discs in a boxed set. The fourth side, also played by the Concertgebouw under Haitink, is given to the Andante-Adagio from the 10th Symphony which Mahler left incomplete. It has typical Mahlerian bitter-sweetness which suggests an almost overpowering perfume. Although Bruno Walter objected to its performance in this incomplete form it will be welcome to most listeners, at any rate all admirers of Mahler. It is prodigal in thematical material, and the chorale-like entry of the full orchestra is quite stunning. Altogether a set that should provide endless pleasure no matter how often it is repeated.

★ ★ ★

DREYFUS — Sextet for Didjeridu and Wind Quintet. Adelaide Wind Quintet with George Winunguj (didjeridu).
GROSS — Trio for Flute, Oboe and Clarinet. Members of the Adelaide String Quintet.
BUTTERLEY — Voices for Wind Quintet.
MEALE — Plateau for Wind Quintet. The Adelaide String Quintet. EMI Stereo OASD 7565.

It was bound to happen — and it has. A didjeridu has been introduced into a wind quintet by George Dreyfus. In her excellent sleeve note on the quintet Kay Lucas tells you all you're ever likely to want to know about this aboriginal instrument. She tells you what it is made of, how it is played, what it can do and what it cannot. Dreyfus has composed an interesting work right away from his often facetious style. You hear legato changes of chromatic clusters, one merging into the next without a break. Meanwhile the didgeridu grunts away complacently underneath becoming more assertive later in the piece. This all goes on in the first section. In the second section the instruments become more active — the untranslateable French word mouvemente perhaps describes them best — then gradually die away leaving the didgeridu croaking like a giant frog.

Later, towards the end of this section, there are some amplified whoops on some instrument I couldn't identify and some short noted stereographic sounds of mysterious origin. They make a final cheeky ending to the work, restoring momentarily the gamin-like image this resourceful composer has deliberately set out to win for himself. Eric Gross' Trio for Flute, Oboe and Clarinet is in four separate movements. Mr Gross furnished his own notes on the sleeve but they do little but parse and analyse the composition and are unworthy of the elegance of the music. The whole work comes off very well technically. The graceful first movement is very easy on the ear, the second is an adagio, lyrical and brief. The third is very difficult to play but quite easy to listen to.

The Butterley work is never as difficult to listen to as Ian Farr's notes on it are to read. It starts with a simple-to-follow flute solo soon joined by a clarinet. A later section has all five voices chattering away industriously. Bassoon and oboe share a dialogue that often comes close to stating a melody. Then comes a section in which the horn is made to do all kinds of unnatural things. The work continues with sometimes all the instruments playing alternately in featured solos. All kinds of combinations are tried, sostenuto chords are contrasted against fast ones and very soon everyone seems to be going his own way without paying the slightest attention to what his neighbour is doing.

The final work is a wind quintet called by the composer, Richard Meale, "Plateau", a name he thought up after he'd finished writing the music. Frankly it is a difficult work and I won't know until I have repeated it several times whether I like it or not.

A word of praise for Eric Dunn who produced the disc for EMI with the aid of Commonwealth Assistance to Australian Composers. The sound is very clean and of good quality and tricky questions of balance all seem to have been solved very satisfactorily.

★ ★ ★

GRIEG — Piano Concerto in A Minor.
SCHUMANN — Piano Concerto in A Minor. Stephen Bishop (piano) and the BBC Symphony Orchestra conducted by Colin Davis. Philips Stereo 6500 166.

Here are two performances of outstanding merit notable for both their youthful freshness and sensitivity. Bishop and Davis are careful not to miniaturise the Grieg into mere prettiness. Their reading adds stature to a work too often regarded as nothing better than an exercise in pastel shaded virtuosity. You may find an occasional tempo a wee bit on the fast side but there is no noticeable sense of strain in achieving the brisk tempo. On the contrary all the performers seem at all times completely relaxed. Try the Finale and note the bouncy rhythms alternating with interludes of beguiling delicacy. It is the best performance of the work that I have heard since the late Julius Katchen and Charles Mackerras played it in the Sydney Town Hall some years ago. And I have listened to many recordings since, though its appearance on concert programs becomes more and more rare.

I can only use the same terms of high praise for the Schumann. Soloist and orchestra offer performances that abound in subtle inflections and the relationship between the two is always in perfect harmony. Indeed so idiomatic is the collaboration between Bishop and Davis that they can dare to add that uniquely impulsive air that pervades so much of Schumann's music. The sound is vivid yet entirely faithful and one must include the engineer's contribution to this highly recommended disc.

★ ★ ★

BARTOK — Violin Concerto No 2. Six Duos for Two Violins. Yehudi Menuhin and the New Philharmonia Orchestra conducted by Antal Dorati. Menuhin and Nell Gotovsky in the Duos. World Record Club Stereo S / 5073.

Violin Concerto No 2. Rhapsody No 1 for Violin and Orchestra. Henryk Szeryng and the Concertgebouw Orchestra conducted by Bernard Haitink. Philips Stereo 6500 021.

Here are two performances of the same work, each of which I find difficult to recommend at the expense of the other. For my taste Szeryng has a slight edge over

Menuhin. He makes the concerto sound as if it is in the general tradition of this type of work and seems more perceptive of its underlying romanticism than Menuhin. Szeryng's is a muscular account delivered with unswerving assurance. He seems more at home in this medium than Menuhin who, nevertheless, offers competition that many might well prefer. Two other considerations might influence your choice. The Menuhin is issued at a club price while the Szeryng is fully priced.

Then there is the matter of the fills. Menuhin uses six of 44 duos designed for teaching purposes all bearing simple titles — Harvest Song, Bagpipes, Arabian Song and so on. All are interesting in their brief way and Menuhin is admirably partnered in them by Nell Gotovsky.

Szeryng chooses the First Rhapsody for Violin and Orchestra. This is a very Hungarian work and will be of particular interest to those who know Kodaly's Hary Janos Suite. Bartok uses the same Hungarian folk song but treats it in a very different manner. Soloist and orchestra give the work a passionate performance, very rhapsodic indeed and an awfully long way from the type of rhapsody written by Liszt. The sound on both these discs is excellent, a point that might well make your choice even more difficult.

★ ★ ★

MOZART — Mass No 19 in D Minor (K626) "Requiem". Edith Mathis (soprano); Julia Hamari (contralto); Wieslaw Ochmann (tenor); Karl Ridderbusch (bass) with the Vienna State Opera Chorus, the Vienna Philharmonic Orchestra and Hans Haselbock (organ) conducted by Karl Bohm. DGG Stereo 2530 143.

In my opinion you'll wait a long time before you hear a better performance than this of the Requiem. I must confess that I like Bohm's slowish tempos — these might deprive the work of a little drama but substitute nobility. True the fugal Kyrie does plod a little but never irritatingly. To me the whole work is an exercise in the grand manner. The soloists are first class, the choir full toned and alert, and the Vienna Philharmonic beyond praise.

By the way, Hans-Gunther Klein's sleeve notes explode the myth of the Requiem's creation. And the true story is even more fascinating than the legend of the mysterious stranger visiting Mozart on his death bed. If you're looking for a performance that stresses the serenity and nobility of the Mass, this is for you. The engineering tends to euphemism but is none the worse for that.

★ ★ ★

MASCAGNI — Cavalleria Rusticana. Complete Opera. Zinka Milanov (Santuzza); Jussi Bjorling (Turiddu); Robert Merrill (Alfio); Margaret Roggero (Mamma Lucia); Carol Smith (Lola); the RCA Orchestra and Robert Shaw Chorale; conducted by Renato Cellini. RCA Mono VIC 6044.

This mono set was first issued in 1954 so that it is getting on for 20 years old. There has been no attempt to disguise its origin. My set is clearly marked "mono". Not surprisingly the orchestral sound is on the shallow side and the vocal part has what would nowadays be regarded as unusual presence. For instance, at customary volume the Siciliana sounds "as if the singer is in the room." Not only is this a

curious effect for opera but it is especially odd when one recalls that this Siciliana is sung behind the curtain before it rises on the first scene. I found it difficult to adjust my set throughout the opera to get some sort of illusion of the opera house. If you turn up the volume to focus the voices you have the orchestra in your lap. Turn it down and everything sounds too remote.

Whatever your adjustment, the Robert Shaw Chorale, accurate and in their own way expressive, sounds a little too genteel for hot blooded Sicilian peasants. After a somewhat tempestuous and unsteady start, Zinka Milanov settles down and sings magnificently by the time the Easter Hymn is behind her. The "Voi lo sapete" is as musical as anyone could desire and carries with it a world of poignancy. Bjorling offers a brilliant performance as Turiddu. His voice is of continuing allure and he never introduces even into the most tearful moments of the score the lachrimosity so dear to certain types of Italian tenors.

Robert Merrill is in fine fettle as Alfio, but Mother Lucia (Margaret Roggero) is never more than a shadowy figure in the background.

Despite its age and a few minor drawbacks this was a memorable performance and one well worth reissuing.

Moreover, to fill the fourth side you have some operatic arias recorded by Milanov when this soprano was in her prime — between 1940 and 1950. She sings "Mira, O Norma" from Bellini's "Norma" with Margaret Harshaw. Surprisingly in this she is troubled by an unusually wide vibrato but her phrasing and pitch are exemplary. Of the others her "Pace, pace, mio dio" from Verdi's "Force of Destiny" pleased me most. Her "Miserere" Scene from the same composer's "Trovatore", in which she is joined by Jan Peerce, I thought only normally good. But her "D'amor Sull'ali rossee" from the same opera I thought a most distinguished performance, despite some minor coloratura difficulties.

An English / Italian libretta of "Cavalleria" accompanies the boxed set of two records but I could find no texts for the arias in my set.

New World Record Club releases

LISZT: COMPLETE PIANO WORKS, Vol 2. France Clidat, piano. Stereo, World Record Club S / 5130-3. (Four-record boxed set.)

Vol 2 in this ambitious series being issued by World Record Club in four-disc boxed sets has the Liszt specialist France Clidat playing the complete Hungarian Rhapsodies (19 in all), the fourth disc being completed by the Rhapsodie Espagnole. Presumably it is not necessary to enlarge on the actual music — even those who have not previously heard them all will be familiar with the general style from hearing the better-known ones. The main question is posed over the performance — integral editions such as this often show signs of strain and weaknesses.

If you listen for them, you will hear a few technical slips here and there in this set. Nothing very serious mind you — an occasional faulty note, a slight stumble in a lengthy run, a weak finish to a phrase here and there — but in the overall achievement of this recording, these can be regarded as insignificant. Indeed, in some respects they add to the attractions of the performance. A machine-like efficiency can be more disturbing. The main thing is that Mlle Clidat is a superb Liszt player, and her strong dramatic style with its romantic overtones as well as her ability to cope with the most difficult passages make listening to this music a thoroughly enjoyable experience.

Some years ago it was fashionable to adopt a supercilious attitude to the music of Liszt. These performances by Mlle Clidat should remove any prejudices from the minds of all but the most biased listener.

A large format four-page leaflet supplied with the set provides a considerable amount of information about the music and Liszt's involvement with the so-called "Hungarian" style. The technical quality is entirely satisfactory. The recording engineer has captured the piano tone very well, and the slight steeliness apparent in Vol 1 is not so much in evidence here. (H.A.T.)

SCHUBERT — PIANO MUSIC. Vols 1 and 2. Noel Lee, piano. Stereo World Record Club S / 5200, 5207.

With these two discs World Record Club commences a series in which all the instrumental music of Schubert for piano solo, or for piano and chamber group, will be presented. This is a noteworthy undertaking, particularly as the unfinished sections of the sonatas have been completed by Noel Lee, and some of the fragments have been completed and arranged to form sonatas. In this way, some supremely beautiful music will be preserved.

Vol 1 has the two sets of Impromptus, Ops 90 and 142, which have been easily the most popular pieces of Schubert's output for piano solo. Vol 2 has the three "Klavierstucke" (piano pieces), written shortly before Schubert's death in 1828, and sometimes also called Posthumous Impromptus; and two Sonatas, No 10 in F sharp minor, No 12 in C major. Both these have been completed by Noel Lee.

On playing these through for the first time I must confess to having been disappointed by some aspects of the performance. In general, these relate to the generally untidy tempos and uneven finger work. More specifically, such matters as the left hand accompaniment of the G flat impromptu of op 90, which is nowhere near smooth enough; the dynamics of the C minor impromptu, op 90, which are not dramatic enough; excessive rubato in the F minor impromptu of op 142, which turns the pathos of this touching music into bathos. I could go on, but I will leave it there. Perhaps the series will improve. I hope so, as Noel Lee apparently is highly regarded as a Schubert player.

Technically, I cannot rate these recordings higher than "fair." The piano tone is slightly on the dull side and the acoustic environment is non-reverberant. Unfortunately, the review copy of Vol 1 had a bad pressing fault in the outside track. (H.A.T.)

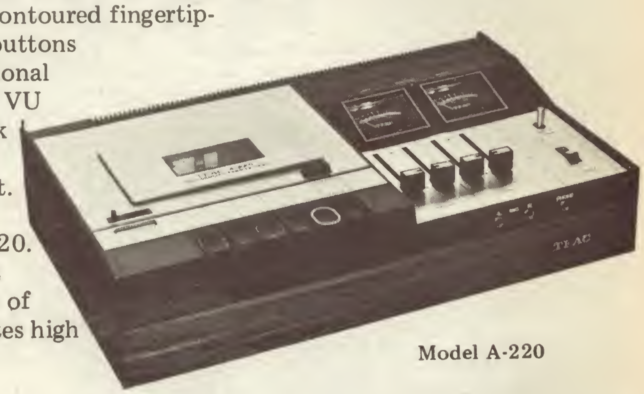
TEAC® brings you the consummate in stereo cassette decks.

Here are three that sum up the best of TEAC technology.

Common to them all is a transport and hysteresis-synchronous drive motor so precise and fool-proof that they can hold their own with some of the best open-reel types. Beyond this, the differences begin. Each model has a package of add-ons for your particular needs.

Model A-210

If all you need is a basic superior deck that can economically record and playback on conventional tape within a frequency response range of 30-12,500Hz, you'll want to look into the A-210. It's outer rotor drive motor holds wow and flutter down to a negligible 0.15%. Separate stop and eject buttons. Low-noise solid-state electronics. Contoured fingertip-control pushbuttons for all operational modes. Large VU meters. Sliding scale record-playback level controls. Standard phone jacks for professional-style 600-ohm mikes and 8-ohm headsets. Strobe-type running light.



Model A-220

If you're looking for a deck that can handle the new chromium dioxide tapes, you should look into the TEAC A-220. It has the add-on feature of a tape selector switch in the CrO2 position, provides recording and playback frequency response of 30-16,000Hz. As an added convenience, the A-220 incorporates high density ferrite heads and separate record and output level controls.

But if you're looking for the definitive Dolby deck with everything you need for near-professional operation, only the A-250 will do. It has TEAC's high-density ferrite heads. These "brown jewels" are so extraordinarily durable that we warranty them for the original owner's lifetime. Add to these a Type B Dolby System that improves the basic signal-to-noise ratio of the A-250 by an additional 10 dB. You can count on superior performance from conventional, high-density/high energy, and chromium dioxide tapes. Add, too, the large expanded-scale VU meters for distortion-free recording at optimum levels and signal-to-noise ratios.

What it all adds up to is that each TEAC cassette deck is the finest available for your particular needs — whatever they are.

Model A-250

If you'd like to know more write to us for the TEAC Catalogue, price list and franchised dealer list.

TEAC. A SOUND IDEA

Sole Australian Distributors:
Australian Musical Industries Pty. Ltd
155 Gladstone St., South Melbourne,
Victoria 3205. Ph: 69-7281
619 Pacific Highway, St. Leonards, NSW 2065
Ph. 439-5752

AMI 144

VARIETY FARE

REVIEWS OF OTHER RECORDINGS

Devotional Recordings

GOSPEL MUSIC'S TOP TEN FOR 1971. Stereo, Canaan CAS-9710-LP (From Sacred Productions Aust, 181 Clarence St, Sydney, and other capitals).

According to the jacket notes, the Gospel songs on this album were nominated as the top ten contenders for the annual award of the Gospel Musical Association of the USA. Representing a wide variation in style, and performed by ten different vocal groups, the album is not too far removed from being a Canaan sampler.

Without naming the groups — most of them well known on the US Gospel scene — the titles are: I Know — I Find No Fault In Him — The Old Rugged Cross Made The Difference — Build My Mansion Next Door To Jesus — He Touched Me — Put Your Hand In The Hand Of The Man From Galilee — If That Isn't Love — The Night Before Easter — The King Is Coming — Jesus, there's Just Something About That Name.

As you will judge from the titles, most of the songs are of recent origin with arrangements to match. However, none of them would qualify for description as "pop" Gospel, likely to estrange those with conservative leanings. All told, it should fit in well for family listening. The last track is especially devotional in character. (W.N.W.)

★ ★ ★

FOR TEENS ONLY. Dallas Holm. Stereo, Teen Zondervan / Pilgrim ZLP-810.

This is the first album of a new label to hand from the S. John Bacon Publishing Co Pty Ltd of 117-9 Burwood Rd, Burwood 3125, Vic. Retail price is $3.95.

The title may tend to deter adult listeners but such a reaction would be premature. Dallas Holm has a smooth and mature voice and a style which will appeal readily to people of any age who are not put off by modern arrangements. The jacket notation about "professional background" is also fully justified and is given point by the fact that the record was produced from the RCA Nashville studios.

The Gospel songs featured are mainly of recent origin but a couple of old ones to modern settings have been slipped in: Two Open Doors — It Is Well With My Soul — Seize Me Lord — Keep On The Right Side Of Life — Oh Happy Day — Then Came Jesus — Beyond A Shadow Of Doubt — God Knows — Satisfied Mind — Something Worth Living For.

The surface and the sound quality are well up to standard and, all told, it is an encouraging and attractively priced introduction to a label new to these columns. (W.N.W.)

★ ★ ★

THE CRIMSON BRIDGE. Stereo, Myrrh MST-6503-LP. (Available from Sacred Productions Aust, 181 Clarence St, Sydney and other capitals).

Myrrh is a new label to these columns, imported from Word Inc, of Waco, Texas. Crimson Bridge is a group of very talented musicians, also new to these columns. Writing, arranging and performing their own material, they exploit a variety of musical form — rock, jazz, latin, blues and acid folk.

If your interest is in musical style and performance, you'll certainly find plenty to listen to in their performance. Side 1 is devoted to five numbers: Better Times — Easy Ways — Comin' — He's Alive — Birthright. On side 2 is a suite by Gary Rand in three movements entitled respectively: "Searching in Reality", "Experience" and "The Beginning of Joy". The message is much more apparent on side 2 and, again, it's good material for the student of pop-style Gospel.

On the other hand, I can't see the album having an appeal for anyone with conservative tastes in Gospel music and lyrics. (W.N.W.)

MEMPHIS CHOIR. Arranged and conducted by Paul Ferrin. Stereo, LPS-74056. (From Sacred Productions Aust, 181 Clarence St, Sydney and other capitals.)

The First Assembly of God Choir, Memphis, Tennessee, has the style and sound of a church choir but the blend, balance and discipline is worthy of a professional group. The music, too, fits the pattern: it employs traditional congregational harmony but the parts are finely balanced, the beat is emphasised gently and there are occasional key changes to combat any risk of monotony.

The track titles: The Eyes of Jesus — Without Him — God Gave His Only Son — I Would Be Like Jesus — Fill My Cup, Lord — Bring Back The Springtime — When I wait Before His Throne — What A Day That Will Be — Healer Of Broken Hearts — Reach Out To Jesus.

Strictly conventional but very, very listenable. (W.N.W.)

★ ★ ★

GREGORIAN CHANT — Vol. 1. The Gregorian Modes. Choeur des Moniales de L' Abbaye Notre-Dame D'Argentan, Director Dom Joseph Gajard. Stereo, Record Society (World Record Club) S / 6420.

Nothing moves me so much as the sheer beauty of a choir of trained nuns singing Gregorian Chant, and this disc kept me absolutely entranced for the whole of its playing time — which is pretty close to one hour. I do not feel I can add much to this. If you have any interest in Gregorian Chant, buy this disc. It is one of the best I have heard. If you are curious to know what Gregorian Chant is all about, this disc will make a fine introduction. The music has been selected from the whole Christian calendar, and most of the modes are represented. A delightful record for those to whom music of this kind has an appeal. (H.A.T.)

Instrumental, Vocal and Humour

THE WORLD OF "YOUR HUNDRED BEST TUNES" — Vol 2. Various artists and orchestras. Stereo, Decca SPA 155.

"Your Hundred Best Tunes" is a BBC program in which listeners nominate their favourite tunes. These are collated and analysed, and then the top 100 are announced and played on BBC 2 network. The ten items here have been chosen by the compere, Alan Keith. It comprises: Fingal's Cave Overture (Mendelssohn) — Miserere (Allegri) — May Safely Graze (Bach) — Elizabethan Serenade (Binge) — 1812 Overture — excerpt (Tchaikowsky) — The Blue Danube (Strauss) — Meditation from "Thais" (Massenet) — Toccata from Organ Symphony (Widor) — Largo (Handel) — None Shall Sleep from "Turandot" (Puccini).

Most of these require no comment, other than to say that they are all very competent performances by well-known artists and orchestras. However, I was particularly impressed by the Allegri work, the interesting history of which is outlined in the sleevenote. It is performed here in magnificent fashion by the famous Choir of King's College, Cambridge, with an outstanding contribution by the young treble singer, Roy Goodman. The disc is worth having for this alone. Binge's popular serenade is performed here by the unlikely combination of three brass bands. I thought I was going to hate this, but was pleasantly surprised by how effective it sounds. Some of the tracks here are quite old, but the sound is acceptably clean. Other tracks are from modern recordings, and are correspondingly better in quality. (H.A.T.)

★ ★ ★

GREAT OPERATIC DUETS. Placido Domingo, tenor, and Sherrill Milnes, baritone. Stereo, RCA Red Seal LSC-3182.

The sleeve boldly claims these are "Two of the greatest voices of our time". I can hardly imagine this view will find widespread support, but most people after hearing this program would, I feel, grant

Reviews in this section are by Neville Williams (W.N.W.), Harry Tyrer (H.A.T.), Leo Simpson (L.D.S.) and Gil Wahlquist (G.W.).

VARIETY FARE . . . cont

that they sing very well, and they seem to have established a fine rapport in duet singing. The program comprises: In un Coupe? O Mimi tu piu non torni from "La Boheme" (Puccini) — Solenne in quest'ora, "La Forza del Destino" (Verdi) — Sogno, o son desto, "I Vespri Siciliani" (Verdi) — Ellui! desso! l'Infante!, "Don Carlos" (Verdi — Au found du temple saint, "Pearl Fishers", (Bizet) — Ah! mille vite. Si, pel ciel, "Otello" (Verdi) — Invano, Alvaro, "La Forza del Destino", (Verdi) — Enzo Grimaldo, "La Gioconda" (Ponchielli).

Whether these tracks were specially recorded, or are taken from existing recordings, I cannot say, but I suspect the former. Whatever the source, the sound is consistently good, clean, with good dynamic range and with commendable clarity which allows the words to be distinguished. A leaflet containing the full texts of the pieces is included. (H.A.T.)

★ ★ ★

VIOLIN ROMANCES. Arthur Grumiaux, violin, with the New Philharmonia Orchestra, conducted by Edo de Waart. Stereo, Philips "Universo" 6580 047.

Beethoven's attractive Violin Romances Nos 1 and 2 are the most interesting items in this collection of short pieces for violin and orchestra. Also included are Romance from Violin Concerto No 2, and Legende, op 17 (Wieniawski) — Reverie and Caprice (Berlioz) — Serenade Melancholique (Tchaikovsky) — Romance in G (Svendsen).

I personally find the Tchaikovsky piece excessively morbid, and it gives me no pleasure to hear it. Apart from this, the disc is a collection of little gems, and Grumiaux, with his sweet, full tone is just the violinist to do them justice. Nice support is provided by the orchestra, not obtrusive, but sufficiently substantial when they are called upon to play the leading role. The sound is first rate.

★ ★ ★

1812 OVERTURE (Tchaikovsky) and WELLINGTON'S VICTORY (Beethoven). The London Symphony Orchestra conducted by Antal Dorati. Fontana 6547 020.

Dorati's recording of the "1812", with its batteries of cannons, muskets and sundry other firearms, created a great deal of interest, and was very popular, when it was first issued some 12 years ago. Now that it is available on the low-priced Fontana label, it will no doubt acquire a renewed popularity. However, it is not for hi-fi addicts. The guns thunder and the muskets crackle realistically enough, and the maximum use has been made of stereo spread for the effects required, but the orchestral sound is thin, and has presumably been cut at rather low level.

"Beethoven's "Battle Symphony" on the reverse side is an interesting novelty, with armies advancing and retreating on left and right speakers (represented by drums and trumpets) and continuous volleys of gunfire throughout the middle section. The musical interest is minimal, consisting mainly of settings of "Rule Britannia," the French marching song "Malbrouck s'en va-t-en Guerre" and "God Save the King." The orchestral role during the battle is about the same as that of a sound track for a modern war film. An interesting novelty to play for your friends, but this cannot be seriously regarded as classical music. (H.A.T.)

★ ★ ★

SIR JOHN BARBIROLLI CONDUCTS GRIEG. The Halle Orchestra. Stereo, His Master's Voice OASD 2773.

This reissue of tracks selected from discs by that noted Grieg interpreter, the late Sir John Barbirolli, makes extremely pleasant listening. It is a very "light" program, comprising: Norwegian Dances, op 15, Nos 1 to 4 — Homage March from "Sigurd Jorsalfor" — Lyric Suite, op 54 — Overture, Dance of the Mountain King's Daughter and Norwegian Bridal Procession, from "Peer Gynt." The only item needing comment here is the set from "Peer Gynt". None of the three pieces listed are included in either of the two suites, so if you already have these, you will not be duplicating if you buy this disc. The sound is fine. (H.A.T.).

★ ★ ★

SPANISH HARP MUSIC. Nicanor Zabaleta, harp. Stereo, DGG 2530 230

Although the disc is entitled "Spanish Harp Music", it is actually arrangements for harp of mainly well known Spanish piano music, such as: Granada, Zaragoza and Asturias, all from "Suite Espagnole" (Albeniz) — Mallorca (Albeniz) — Tango Espagnole (Albeniz) — Spanish Dance No 5 (Granados) — Toccata and Fugue from "Ciclo Pianistico" (Turina). Items by lesser known composers are: Apunte Betico (Guerra) — Sonatina from the ballet "Danza de la Pastora" (Halffter) — El Viejo Castillo Moro (Chavarri). This is all charming and tuneful music, and it all transcribes for harp very well. As one of the world's leading performers on this instrument, Nicanor Zabaleta plays beautifully, and despite the limited means of expression of the harp, conveys a good deal of the poetry, if not the passion, of the originals. The recording quality is faultless. (H.A.T.)

★ ★ ★

THE WORLD OF THE IMMORTAL CLASSICS. Frank Chacksfield and his orchestra. Stereo Decca series 275 SPA-176.

Real mood music this — music to do anything by that could benefit from music like this! Probably the most familiar themes from the classical field, played and replayed in every conceivable context, they have been arranged here for presentation by a predominantly "singing-string" orchestra:

Clair De Lune (Debussy) — Minuet In G (Beethoven) — The Swan (Saint-Saens) — Salut D'Amour (Elgar) — Waltz Of The Flowers (Tchaikovsky) — Liebestraum (Liszt) — Melody In F (Rubenstein) — Morning Song (Grieg) — Humoresque (Dvorak) — Air on The G String (Bach) — Valse D'Ete (Alstone).

If you're partial to singing strings, you'll probably be quite receptive to these very well known and tuneful snippets, whether for listening or for background. The string tone is a trifle rough but not enough to disqualify a budget-priced disc if the contents appeal. (W.N.W.)

BEETHOVEN — Piano Concerto No 4 in G. Claudio Arrau, piano, with the Concertgebouw Orchestra, Amsterdam, conducted by Bernard Haitinck.

Claudio Arrau's playing in this, one of the most lyrical piano concertos, is of the standard which earned him the accolade, "the world's best pianist"; beautifully controlled, yet entirely fluid. And no doubt inspired, by the masterly performance of the soloist, the orchestra is in fine form, providing an exemplary accompaniment under Haitinck's direction. It is a pity therefore that the recording is not entirely satisfactory. There is a slight woolliness in the piano tone in some passages. I doubt whether this can be attributed to the soloist, whose fingerwork has always been exceptionally clean. Despite this slight drawback, I would recommend this fine performance to anybody looking for a recording of this popular concerto — particularly as it is realeased on a budget priced disc.

★ ★ ★

THE SOUND OF VIENNA. The Johann Strauss Orchestra of Vienna, conducted by Willi Boskowsky. Stereo, Columbia Studio 2, TWO 368.

The demand for Viennese music must be insatiable, to judge by the continuing stream of discs to cater for it. If your taste runs in this direction, and you want the best, it is hard to imagine any finer interpreters of Strauss and his fellow composers than the Johann Strauss Orchestra of Vienna, with Willi Boskowsky conducting. These are specialists, and if you are sensitive enough to interpretations to detect the famous lilting quality of the genuine Viennese musician when playing this music, you will not be disappointed in this performance. If you listen carefully, you will detect the slight anticipation of the up beat in the waltzes which gives the music this special quality.

Apart from the famous "Radetsky March" of father Strauss, and the inevitable "Blue Danube" (will there ever be a disc of Viennese waltz music without this?) the contents avoid the overplayed numbers: Postscriptum — Polka (Millocker) — Fatinitza March (Suppe) — Boccaccio Overture (Suppe) — Champagne Polka (J. Strauss II) — Romantiker Waltz (Lanner) — Plappermaulchen Polka (Lanner) — Seufzer Galop (J. Strauss I). The sound is satisfactory, with good stereo spread. (H.A.T.).

★ ★ ★

FIEDLER'S FAVOURITE MARCHES. Arthur Fiedler and the Boston Pops Orchestra. Stereo, RCA Red Seal 2-record set VCS-7068.

Twenty-seven marches strung end to end pose quite a test of endurance but, unless you happen to be a reviewer, there's nothing to say that you must hear them all at a sitting! But, if you are partial to march tunes, or lack them in your collection, this $8.40 2-record set from RCA is well worth considering.

The Boston Pops Orchestra is at its considerable best playing music of this type, full of vigour and orchestral weight. And RCA engineers have come to the party with some top-flight recording.

Space forbids the listing of all the titles but here are a few: Radetzky March (J. Strauss) — Pomp And Circumstance(Elgar) — Procession Of The Sardar (Ippolitiv-Ivanov) — 76 Trombones (Willson) — Turkish March (Beethoven) — March Of The Toys (Herbert) — Adia Grand March (Verdi) — Parade Of The Wooden Soldiers (Jessel) — Semper Fidelis (Sousa) — Colonel Bogey (Alford).

Add another 17 and you'll have all the marches you need for many a long day! (W.N.W.)

★ ★ ★

KING HENRY IV, Part 1. Stereo, World Record Club "Living Shakespeare" series, S / 2507. Supplied with booklet containing the full text of this condensed version.

This "Living Shakespeare" series has appeared perenially in the World Record Club câtalogue for a number of years now. The series was highly praised when it first became available, not only on account of the high standard of acting, but also for the skilful way the texts have been abbreviated to maintain the essentials, and the excellence of the recordings.

This disc of "Henry IV," Part 1, has the noted actor Donald Wolfitt in the part of Sir John Falstaff, and obviously this is the outstanding performance. However, noteworthy are Ernest Milton as the King, Richard Gale as Prince Henry and Sean Connery as Hotspur (Connery had not acquired his present fame when this series was recorded over ten years ago.) For those who cannot aspire to full length Shakespeare, but who would like to become acquainted with the poet's major works, this series is highly recommended. (H.A.T.)

Already discerning enthusiasts have set two recently released

And it's not

Both Sansui products . . . the Model 210A stereo tuner/amplifier and the Model AU-101 stereo control amplifier . . . offer extraordinary value for money. In terms of sheer performance no other similarly priced amplifier available in Australia today can match or surpass the 210A or the AU-101, including some products *twice the Sansui price.*

SANSUI MODEL AU-101 STEREO AMPLIFIER

Two leading Australian electronics magazines have reviewed the all low-noise silicon transistor Sansui Model AU-101. ***"Electronics Australia"*** (August, 1971) says . . . *"the best comment we can make about the AU-101 is that few amplifiers, regardless of price, give an overall test result as good as this. This makes it a real bargain at the very reasonable price".* ***"Electronics Today"*** (May, 1971) says . . . *"Surprise Packet" . . . "Performance of the Sansui AU-101 belies its low price" . . . "The hum and noise performance are both very good and better than most other amplifiers at twice the price" . . . "The Sansui AU-101 is a very good buy, particularly at the price".*

There you are . . . unbiased comments from two leading publications. What precisely does the Sansui AU-101 offer? Look at these specifications!

AU-101 Specifications:— ● Music power: *50 watts at 4 ohms, 44 watts at 8 ohms.* ● R.M.S. power: *36 watts at 4 ohms, 30 watts at 8 ohms.* ● Total harmonic distortion: *Less than 0.8% at rated output.* ● Frequency response: *20-60,000 Hz. ± 2 dB.* ● Channel separation: *Better than 45 dB.* ● Input sensitivity: *3 mV. (Magnetic cartridge), 4 mV. (Microphone), 200 mV. (Auxiliary and Tape Recorder).* ● Dimensions: *16" x 11" x 4⅝".* **Price:** *$149**

SANSUI MODEL 210A STEREO TUNER/AMPLIFIER

The recommended list price of the Model 210A stereo tuner/amplifier is only $ 213.50. Power output is 34 watts music power into 4 ohm speaker systems or 22 watts R.M.S. Frequency response is 25-30,000 Hz. ±2 dB. and extends well beyond this figure. Sensitivity of the power amplifier suits magnetic cartridges at 3 mV. and 180 mV. sensitivity caters for auxiliary inputs and tape recorders.

An easily read panoramic tuning dial simplifies selection of radio stations on AM/MW or AM/SW bands; a signal strength meter operates on the AM band. Selectivity is an almost unbelievable 40 dB. making the 210A the *most selective receiver Sansui has ever made.* This radically improved selectivity is directly attributable to Sansui's use of two ceramic filters each with two filter elements in the 210A's I.F. amplifier section. A whistle filter eliminates unpleasant interference and noise on weak AM stations. Every desirable control is provided in the Sansui 210A . . . a DIN socket for tape recorders, headphone jack, flexible bass and treble controls, a direct tape monitor switch, loudness control and clearly marked selector switch.

When you call at your franchised Bleakley Gray dealer to hear the Sansui 210A, *listen critically.* You'll be agreeably surprised with the audible difference Sansui quality makes. Only Sansui — Japan's leading audio only manufacturer — could design and manufacture an outstanding stereo tuner/amplifier expressly for Australian conditions and keep the price down to only $ 213.50.*!

Sansui

See your Bleakley Gray franchised dealer!

***IMPORTANT: Prices quoted in this advertisement are suggested consumer prices only.**

Sansui Distributors: Australia, excluding W.A.:

Bleakley Gray Corporation Pty. Limited.

Head Office: *28 Elizabeth Street, Melbourne. 3000. Tel. 63 8101*. Telex: 31904.* ***Sydney Office:*** *53 Victoria Avenue, Chatswood, N.S.W. 2067. Tel. 40 4522*.* ***Canberra Office:*** *25 Molonglo Mall, Fyswick, A.C.T. 2609. Tel. 95 6526.* ***Adelaide Office:*** *301 South Terrace, Adelaide, S.A. 5000. Tel. 23 6219.* ***N.T.:*** *Pfitzner's Music House, Smith Street, Darwin. 5790. Tel. 3801.* ***Qld.:*** *Sydney G. Hughes, 154-158 Arthur Street, New Farm, Brisbane. 4005. Tel. 58 1422.* ***Tas.:*** *K. W. McCulloch Pty. Ltd., 57 George Street, Launceston. 7250. Tel. 2 5322.*

W.A. Distributors: *Atkins Carlyle Ltd.,* 1-9 Milligan Street, Perth. 6000. Tel. 22 0191.

Australian stereo new sales records for SANSUI AMPLIFIERS.

surprising.

Sansui equipment is manufactured by:

Sansui Electric Co. Ltd.,
14-1, 2-chome, Izumi,
Suginami-ku, Tokyo, Japan.

SX2-EA-10 72

Ask for full details. Send the coupon right away and we'll send you all the facts!

**Bleakley Gray Corporation,
28 Elizabeth Street,
Melbourne, 3000.**

Please send me complete technical details on the Sansui Model 210A/AU-101 and the name of my nearest Bleakley Gray franchised dealer.

NAME..

ADDRESS..

......................**POSTCODE**..................

VARIETY FARE . . . cont

BRASS IN ACTION. The Fairey Band. Camden stereo CAS-7147.

Formed in 1937 at the Fairey Aviation Works in England, the Fairey Band is one of the finest brass bands in the world. It is conducted by Kenneth Dennison and with musical direction by Harry Mortimer the record is doubly attractive at the Camden price of $2.95. Apart from the price, the record is the best I've heard as an accurate reproduction of a brass band. Many records are disappointing in this respect.

Twelve tracks are presented: Entry Of The Gladiators — Take A Pair Of Sparkling Eyes — Soldier's Chorus from Faust — Spring — Fame And Glory — La Donza — When The Saints Go Marching In — Angels Guard Thee — Hungarian Dance No 5 — To A Wild Rose — Knightsbridge March — Marching With Sousa.

If you are sampling the disc, try the last-mentioned track (L.D.S.).

★ ★ ★

CALYPSO A LA CARTE. Roberto Delgado and his orchestra. Polydor stereo 2371 007.

If you like calypso music then this lively album from Roberto Delgado and his orchestra is a good buy. Indeed this is the best record that Roberto Delgado has had for some time.The sound quality is very good and the stereo spread wide.

Twelve tracks are presented: Angelina—Jamaica Farewell — —Jump In The Line — These Are The Times — Soul Calypso — Mama Look-A-Booboo — Rum And Coca Cola — Island In The Sun — Creole Dance — Coconut Women — Banana Boat Song — Matilda. (L.D.S.).

★ ★ ★

THIS IS JOHN WOODHOUSE. John Woodhouse and his Magic Accordion. Stereo, Philips International Series 6440 067.

John Woodhouse plays an amplified accordion which is somewhat unusual in appearance, in that instead of the usual two of piano type keys for the right hand it has rows of buttons. The advantage of this is that it allows a far wider range of facilities, and in fact it can be regarded as a miniature electronic organ. A count of the buttons from the cover picture shows that there are 102 for the right hand and 120 for the left hand — far more than the normal piano accordion.

Whatever the virtues of the instrument, it sounds like a small electronic organ, and as such its appeal must be limited, judged purely on aural presentation. However, if you bought and liked the earlier disc, this one has a very attractive program: Barcarolle — Skaters' Waltz — Espana Waltz — Can Can — Plaisir D'Amour — La Petite Tonkinoise — O Sole Mio — Santa Lucia — Funiculi, Funicula — Come Back to Sorrento — Tango des Roses — La Comparsa. Whether you will like the way these are played, or the contribution from a shrill whistler in "Sorrento," it would be best to discover for yourself by asking your dealer to let you hear a track or two. The sound is clean and lifelike, and I am sure it has accurately reproduced this instrument's particular timbre. A small rhythm section provides a background to the soloist. (H.A.T.)

CLARINET FASCINATION. Henry Arland and the Hans Bertram orchestra. Polydor stereo 2371 208.

For those of you who have not heard of him, Henry Arland must be one of the smoothest clarinet players around. He is backed by a very professional orchestra and the musical arrangements are highly satisfactory. The arranger has even managed to make a tune like "Yellow River" interesting. Sound quality is tops.

Eleven more tracks are featured: Merry Go Around — Einsamer Sonntag — Bugle Call Rag — My Sweet Lord — Mamy Blue — Drina Marsch — Caravan — Only You — Raindrops Keep Fallin' On My Head — Wild Cat Blues — Sportraken. (L.D.S.)

★ ★ ★

THE GODFATHER. Music from the film played by Neil Richardson and his orchestra. Axis stereo 6040.

Many people will buy this record for the "Love Theme" and nothing else since it is currently being given plenty of air play on radio stations. But it is not necessary to have seen the film for the music to be appreciated. It has an interesting "tragic" atmosphere and theme right throughout which makes it well worth listening to. Sound quality is standard.

Besides the love theme, eleven other tracks are presented: I Have But One Heart — The Pickup — Connie's Wedding — The Halls Of Fear — Sicilian Pastorale — The Godfather Waltz — Apollonia — The New Godfather — The Baptism — The Godfather Finale — Main Title. (L.D.S.).

★ ★ ★

BIG HITS OF THE 20's. Enoch Light and the Light Brigade. Stereo, Project 3 (Festival) SPJL-934467.

Whether up with the times or back among the nostalgics, Enoch Light can be relied upon to give a good account of himself. This album is no exception. The style, the orchestrations, the tempos belong to the twenties; only the stereo sound is up to date — well balanced, well spread and free from noise and distortion.

Titles include: Happy Days Are Here Again — Chicago — If You Knew Susie — Sometimes I'm Happy — Tea For Two — Yes Sir, That's My Baby — Charleston — Four Leaf Clover — Somebody Loves Me — Bye Bye Blackbird — Ain't She Sweet — Toot, Toot Tootsie.

Remember those old timers? If you do, you'll enjoy them all over again. Too young? Have a listen, all the same! (W.N.W.)

★ ★ ★

FEMMES. Franck Pourcel and his orchestra. Columbia stereo SCXO-8004.

It must be admitted that endless songs can be sung about "Femmes" but a collection of songs with feminine names is somehow less than inspiring. Like their live counterparts the songs are too diverse for the music to have any theme. Franck Pourcel has attempted to tie them all together (and so he should) but the result is rather bland. Sound quality is okay.

The titles of the ladies are: Eloise — Laura — Hello Dolly — Lily Marlene — Ma Louise Maria Elena — Maria — Eleanor Rigby — Mrs Robinson — Delilah — Brigitte — Cecilia. (L.D.S.).

A TASTE OF GUITAR. Hekki Laurila with studio orchestra. Axis stereo 6030.

Heikki Laurila is an acoustic guitar player with a style a little reminiscent of Tony Mottola. The arrangements on this record are pleasant and the studio orchestra provides competent backing. Sound quality is good. At $2.50 it is good background for dining or quiet relaxation.

Twelve tracks are featured: What A Wonderful Feeling — Hide Your Heart Away — Can't Stop Loving You — For The Love Of Him — Yesterday I Heard The Rain — Snowbird — Tears Go By — If I Thought You'd Ever Change Your Mind — Rain Of Love — Tutto O Niente — All Of A Sudden — Surround Yourself With Sorrow. (L.D.S.).

★ ★ ★

HAMMOND FASCINATION. T. W. Ardy, with Hans Bertram and his orchestra. Stereo, Polydor 2371-207.

Some strict tempo albums can make for rather monotonous listening, whatever their merits for dancing. The criticism cannot readily be levelled against this one. While the tempo is pegged to the percussion beat, the sound is constantly changing from organ to instrumental to chorus.

The jacket notes mention a total of 28 tunes distributed across the ten tracks. Without attempting to mention them all, you'll find amongst them: You Are My Sunshine — Love Story — Swinging On a Star — Some Of These Days — Put Your Hand In The Hand — Light My Fire — Lara, and many others, some with German titles.

In line with Polydor's reputation, the sound is clean and well balanced. Good party music, whether for dancing or as a lively background. (W.N.W.)

★ ★ ★

THE GODFATHER. Music from the soundtrack. Stereo, Horizon (Festival) SH66 94089.

Because of the somewhat ambiguous wording on the sleeve note, I am inclined to doubt that this is the original soundtrack music, but it is certainly so closely styled to it that it could easily pass as such. The fact is that this very attractive music is performed here with a high degree of professional competence, the quality of the recording is very good, and the price is only $2.59. This music has become very popular of late, and if you want a recording, this one may be regarded as excellent value at the price. (H.A.T.)

★ ★ ★

ANDY BAUTISTA PLAYS YAMAHA. Stereo, Parlophone Series 275 SPMEO 9903.

The Yamaha featured in this album is the big EX-42, notable for its three manuals, its variety of voices and effects and its way-out styling.

Andy Bautista never attempts to make it sound like anything but an electronic organ, a remark which might tend to put off those who prefer traditional popular organ style and voicing. But don't go away! Without ostentation but with loads of skill, he works through the numbers and the effects, managing to sound, most of the time, like a one-man combo!

The titles: Summertime — Mercy, Mercy, Mercy — Spinning Wheel — Tomorrow's Love — Downtown — My Sweet Lord — Wives And Lovers — Impossible Dream — For Once In My Life —

a new excellence with Dual 1229

Here's 12 reasons why!

1 Built in illuminated strobe with adjustable view angle for 33 1 / 3 & 45 rpm.
2 Dynamically balanced, non magnetic 12'' diameter, die cast platter of 6.8 lbs weight.
3 Extended length precision tonearm with minimum horizontal tracking error, and four point gimbal suspension.
4 Mode selector for maintaining correct vertical tracking angle in either single play or changer mode.
5 Fully synchronous, continuous pole heavy duty motor.
6 Removable cartridge holder accepts all cartridges with ½'' centres and 1-12 gram weight.
7 Silicon damped Cue Control.
8 Continuously variable antiskating adjustment with separate calibrations for conical and elliptical style.
9 Pitch Control, independent of load or line voltage, adjustable over one semi tone range (6% on all speeds)
10 Unweighted Rumble $>$ 63dB
Weighted Rumble $>$ 42dB
11 Wow & Flutter $\leqq \pm$ 0.06%

Dual

FRED. A. FALK (SALES) PTY. LTD.

28 KING STREET, ROCKDALE, N.S.W. 2216
PHONE 599 3722

VARIETY FARE . . . cont.

Love Story — Samba de Orfeo.

It grows on you as you listen, which is another way of saying that you won't regret having paid the modest budget price ($2.75) for this one. (W.N.W.)

★ ★ ★

HAPPY DANCING 5. Robert Last and his orchestra. Decca stereo SKLA 7681.

Whether or not Robert Last is related to James Last is a matter for conjecture as this record has no sleeve notes. Their playing styles are certainly similar so if you like one you will probably like the other. No doubt Decca are banking on it.

No less than 26 tunes are presented, in medley form. Recording quality and stereo spread are standard. Some of the titles are as follows: Sugar Sugar — She's A Lady — Another Day — Rose Garden — Joy To The World — My Sweet Lord — Only For You — Amazing Grace. (L.D.S.)

★ ★ ★

THE STRIP GOES ON. Werner Muller and his orchestra. Decca stereo SKLA 7679.

If sexy covers sell records then this is sure to sell. But women's liberationists will not be happy with the curious garb of the model on this cover. If you buy the record for the cover alone you will probably be satisfied but the music is quite unremarkable. Quality is okay.

Perhaps the list of tracks may excite you: Bodybuilding — Too Darn Hot — Femme Femme — The Beat Goes On — Je T'aime . . . Moi Non Plus — Englechen — The Stripper — Oh Baby It's Cold Outside — Satisfaction — Get Up I Feel Like Being A Sex Machine — Strip Strap Stroll — Rumba Juanita. (L.D.S.)

★ ★ ★

MANTOVANI PRESENTS: Axis stereo 6021.

Mantovani fans are sure to rush this disc. The man who started it all with "Charmaine" back in 1951 is still going strong in 1972. He certainly has not lost his touch when it comes to arranging popular music for easy listening. And if his reputation were not enough, the price of $2.50 for Axis records makes it a bargain.

Surface noise is noticeable on some tracks but this should not worry most listeners. Otherwise the quality is good.

There are 12 tracks: Chitty Chitty Bang Bang — Born Free — September In The Rain — Never On Sunday — Red Roses For A Blue Lady — Puppet On A String — Do Re Me — A Summer Place — Yesterday — Mexican Hat Dance — Elvira Madigan — Hello Dolly. (L.D.S.)

★ ★ ★

IT'S TOO LATE. Ferrante & Teicher, duo pianists. United Artists stereo SUAL 934360.

In the past, one could associate scintillating piano playing with the duo pianists, Ferrante and Teicher. However if you were to judge by the standard of this record then that no longer applies, for the performance is mediocre and the arrangements mundane. Worst of all, the recording quality is lousy and this is a full-priced record.

Twelve tracks are featured: It's Too Late — You've Got A Friend — Put Your Hand In The Hand — Rainy Days And Mondays — Love Story — Gitchie Goomie — Proud Mary — For All We Know — Mozart Symphony No 40 (1st movement) — It's Impossible — Applause — Once Around The World. (L.D.S.)

★ ★ ★

COME FROM THE SHADOWS. Joan Baez, vocals, with orchestra. Stereo, A & M (Festival) SAML 934557.

This is Joan Baez's first album for A & M, and although the label is different, the contents are very much as before. Joan continues her campaign of protest against war, injustice, poverty and the other evils of our civilisation, which she has been conducting now for ten years or so. She has provided her own sleeve note, in which she outlines her views on these matters for those who may not yet be aware of them. However, the contents of this disc are not all concerned with such matters. With such predictable items as "Song of Bangladesh" and a further attack on the prison system in "Prison Trilogy," there is mingled some ballad type material concerned with the nicer aspects of life. The 12 titles include: Rainbow Road — Love Song to a Stranger — Myths — In the Quiet Morning — To Bobby — Tumbleweed — Imagine. Joan's fine singing voice is supplemented by the usual consort of guitars and small orchestra. I thought her voice did not have its usual superb clarity in this recording, but the sound is otherwise of good standard. For Joan Baez fans, recommended. (H.A.T.)

★ ★ ★

MORE GOLDEN GEMS FROM THE ORIGINAL CARTER FAMILY. Camden (RCA) CAS-2554 (stereo effect).

As I have a Carter Family fan in my own family, I am able to report by proxy that this disc is "beautiful." Which proves, if nothing else, that beauty is not only in the eye of the beholder but also in the ear of the listener. Frankly, I find the Carter Family brand of entertainment a bit too homespun, with their nasal mountain country kind of delivery, and their corny lyrics. Yet that they exercise a special kind of appeal cannot be denied. After all, if tracks they made over 40 years ago still command a ready market, they must have special qualities, and even if these are not evident to me, others apparently discern them readily.

Well, there it is. If you are a Carter Family fan, a fellow admirer assures you this is "beautiful." The titles: Little Log Cabin in the Sky — Anchored in Love — Little Darling, Pal of Mine — I'll be Home Some Day — I Have No One to Love Me — Will the Roses Bloom in Heaven — Hello Central, Give Me Heaven — Sunshine in the Shadows — I Never Will Marry — There's No Hiding Place Down Here. It should be evident from the titles that some of these songs have a devotional character — a few more and it would have qualified for the devotional section of these reviews. These old tracks have been well remastered by RCA engineers. (H.A.T.)

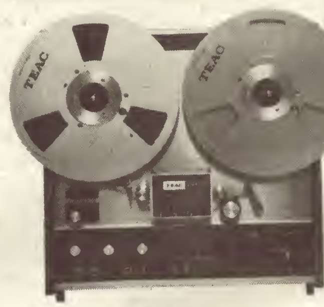
★ ★ ★

THE PLAYBOY SONG. Homer and Jethro. RCA Camden stereo CAS-2315.

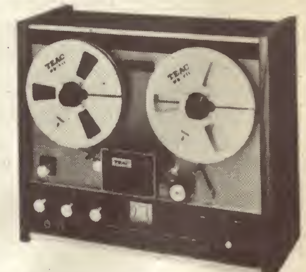
The songs presented on this album may have been regarded as funny back in the 1920s but they certainly are not in the 70s,

Bi-directional record and playback tape deck
Model A-4070
• 4 Ferrite heads (6 head function). • Reel size 7" • Tape speed 3¾ ips and 7½ ips • Triple motor mechanism • Wow and flutter .06% at 7½ ips o F/R 25 to 24,000Hz at 7½ ips • S/N ratio 58 dB

Make music- not noise



Stereo Tape Deck
Model A-3300
• Reel size 7" • Tape speed 3¾ ips and 7½ ips • Triple motor mechanism • Wow and flutter .06% at 7½ ips • F/R 25 to 24,000Hz • S/N Ratio 55 dB



Stereo Tape Deck
Model A-1230
• 3 heads-4-head function • Reel size 7" • Tape speed 3¾ ips and 7½ ips • Triple motor mechanism • Wow and flutter .08% at 7½ ips • F/R 30 to 22,000Hz at 7½ ips • S/N Ratio 55 dB

You may not realise it, but until now, even the best tape decks allowed a degree of noise during recording and playback. This may have been all right for conventional tapes, since they were far from perfect. But with the recent introduction of the low noise/high output tapes, it's no longer permissible.
Which brings us to a new generation of decks by TEAC. And TEAC calls them Superior Sound/Low Noise decks: decks designed to get the most out of the low noise tapes as well as the conventional types.
Five of these new generation decks are described here. If you'd like to know more, write to us and we'll send you the TEAC Catalogue, price list and franchised dealer list

Automatic Reverse Stereo Tape Deck
Model A-1250
• 3 heads-4-head function • Reel size 7" • Tape speed 3¾ ips and 7½ ips • Triple motor mechanism • Wow and flutter .08% at 7½ ips • F/R 30 to 22,000 Hz at 7½ ips • S/N Ratio 55 dB

Combination Head Stereo Tape Deck
Model A-1030
• Reel size 7" • Tape speed 3¾ ips and 7½ ips • One motor mechanism • Wow and flutter .08% at 7½ ips • F/R 30 to 22,000Hz at 7½ ips • S/N Ratio 55 dB • Auto Shut-off

TEAC
A SOUND IDEA

Australian Distributors: Australian Musical Industries Pty. Ltd., 155 Gladstone St., South Melbourne Vic., 3205. Ph. 69 7281
619 Pacific Highway, St. Leonards, NSW 2065 Ph. 439 5752

AMI 145

VARIETY FARE . . . cont.

just sick. They may appeal to pixillated pensioners but no-one else.

Still interested? The tunes are: Goodnight Irene — After the Hangover's Over — Jimmy Drinks Corn — Rye Whiskey — I Don't Give A Hoot (for the Nanny) — Fractured Folk Song — So Long — The Funny Farm — The Playboy Song — Mama Don't Whip Little Buford. (L.D.S.)

★ ★ ★

LAUGH WITH THE COMEDIANS. Various artists. Mono, HMV OELP-9894.

Obeying the call of duty, I've listened to so many unfunny comedy records through the years that I approached this one with diffidence. However, by the time it had finished, I'd had more belly laughs than I can remember in many a long day!

There's a few old jokes and a sprinkling of mildly off-colour humour but most of it completely and refreshingly funny. It also provides an object lesson in presentation for any would-be comedian.

The record came from the Granada television series "The Comedian" and, all told, eleven accomplished comedians are featured in rapid succession. One of EMI's budget-priced series you shouldn't miss it! (W.N.W.)

Jazz and Rock . . .

BAD PENNY BLUES. Ray Price Quintet. ATA stereo SATAL 934569.

"Margie" which opens the album is a jazz warm-up for a session with the eclectic Mr Price and his group. They play all of the styles and seem happiest with something around the feel and pace of a Benny Goodman small group. "Bad Penny Blues" is an old Humphrey Littleton number which the Price group play well. A better blues is "Big House Blues," played mostly as a trumpet solo. This unfortunately features a wandering stereo piano solo, one of those things which wanders from left speaker to right and back again. Bad enough in the room but absolutely disconcerting while wearing headphones.

"Buddy Bolden Blues," "Mississippi Mud," "St James Infirmary," "Sheik of Araby" and "Mack the Knife" are some of the jazz standards played nostalgically on the album. (G.W.)

★ ★ ★

GOODUNS. King Biscuit Boy. Daffodil stereo SDDL 934505.

King Biscuit (real name Richard Newell) has a raw style with the blues, a quality which sets him apart from the electric blues performers. He sings, plays fiery harmonica and features crashing chords on the slide guitar, particularly on "The Boogie Walk." Biscuit Boy deals in the blues of the city, stories of unfaithful women and weak-willed men.

"Lord Pity Us All" was written by Dr John the Night Tripper. It throws in some gospel. The record was made in Canada. "Bald-headed rhumba boogie" is New Orleans music, but unlike the jazz which record collectors usually associate with that centre. The accompanying band varies in size and strength from two piece to six, with added strings at times. (G.W.)

SOMETHING / ANYTHING? Todd Rundgren. Bearsville stereo 2BX 2066.

It is difficult to be completely enthusiastic for Rundgren's efforts in creating three of this album's four sides on his own. He sang, played all instruments, recorded and mixed the whole lot.

The first side consists of ballads, featuring the popular single "I Saw the Light." Oh yes, he composed everything, too. The second side is supposedly witty: Rundgren gives a lecture on recording faults and demonstrates a few. I couldn't get the point of this because apart from the deliberate "mistakes" track, his panel technique is faultless. Perhaps he is taking an ungenerous swipe at other people. He plays keyboards on most of the tracks on this side, including "Saving Grace," an exciting rocker and the best track on the album.

Side three features guitar rock played by big bands (all Rundgren). He sounds like Paul McCartney for the vocal on "Couldn't I Just Tell You." In fact he is quite in the grip of the mid-era Beatles for this side.

The fourth and final side is a jam session with other musicians. What a relief it is. You don't realise how concentrated and taut the multi-track numbers are until you plunge into the group performances. They represent good hard music, in the Rolling Stones style and the two most successful numbers are "Slut" and "Dust in the Wind." Rundgren has produced a number of LPs for other people including The Band's "Stage Fright," and the "Badfinger" LP for Apple. (G.W.)

★ ★ ★

HOBO'S LULLABY. Arlo Guthrie. Reprise stereo MS 2060.

Arlo Guthrie hasn't really settled down to a singing style on this, I think his third LP. He selects good songs but doesn't perform them with a consistent style. This LP has the best grouping of songs so far. In addition it features a very strong country blues band with impressive guitar and ukulele playing.

"Ukulele Lady" is a novelty which has moved over into the pop charts. Arlo is capable of deeper performances as he shows on his performance of his father's song "1913 Massacre." "The City of New Orleans" about a famous express train is another good song but I can't get enthusiastic about the way he handles "Hobo's Lullaby" and some of the others. (G.W.)

★ ★ ★

HONKY CHATEAU. Elton John. D.J.M. stereo SDJL 934588.

"Honky Cat" which opens this album is so typical of Elton John's style that it should be filed away as the definitive performance by this talented artist. It has the back beat and the tunefulness, together with the coquetry, of the Elton John piano style.

The album was recorded in France and some of the songs are in the sad-happy style favoured by French singers. Violinist Jean-Luc Ponty is an exciting addition on "Mellow." Ponty plays electric violin — a unique listening experience. Another track which is out of the ordinary is "Think I'm Gonna Kill Myself," featuring an exaggerated lyric and tap-dancing by "Legs" Larry Smith of the Bonzo Dog Band.

Forever a showman, Elton John delivers good value on this LP. (G.W.)

SPEAKER ENCLOSURES

MAGNAVOX 8 / 30 SYSTEM

1.6 cft complete $58.00ea. Magnavox Speakers 8/30 $17.00 p.p. $1.50
3TC $3.40 p.p. 50c
1.6 Cabinet Kit $22.00

FAMOUS MULLARD / MAGNAVOX BOOKSHELF SYSTEM

6WR MK5-3TC. 8 or 16 ohms 15½ x 8½ x 8½ complete
$31.50 ea
Cabinet only $13.90

50 WATT SOLID STATE GUITAR AMPLIFIER

50 watts RMS. solid-state guitar amplifier PM125 4 inputs, 2 channel with separate volume, bass and treble controls; speed and intensity controls for vibrato. Remote foot switch with plug and lead. Black vynex carry cabinet. Kit of parts $98.00
Fully constructed and ready for operation off 240VAC **$114.00**

GUITAR SPEAKER CABINET

Upright floor model, black vynex covering, 34" x 18" x 12", sloping front, contains innerbond packing and two Rola 12U50 12" speakers.
$115.00

PHILIPS

Model AD 0160/T8 1" Dome Tweeter, $12.00.

HORN TWEETER

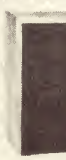
8 OHMS. 20-20,000HZ. 20 watts. ONLY $4.35

MUSICOLOUR II

As per E.A. Dec. '71, Jan. '72. Complete kits of parts $49.50
Fully constructed $59.50
Pack & post 75c
P.C. BOARD ONLY $3.25
SPECIFIED TRANSFORMER ONLY $4.35

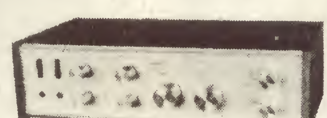
Low-cost compact Loudspeaker System

(Featured Aug. 72 E.A.)



Fully constructed ready for use.
$35.50. P & P $1.50

MSP LF-6WAC Speaker	$10.50
MSP LF-6WACX speaker	$11.50
MSP 4MBC Tweeter	$4.50
Oiled Teak Compact Cabinet	$14.50



SONATA NS-1600D

All silicon solid state Hi-Fi Stereo Amplifier. 10 watts RMS per channel. Each channel has separate Bass Treble controls. Inputs for magnetic or ceramic cartridge, crystal mic., radio, tape — tape out; stereo headphones. 8 — 16 ohms. Instruction booklet, circuit supplied. Timber cabinet. Dimensions. 14½" x 8" x 4". Price $67.50. Pack and Post $1.50. Interstate $2.50.

HI-FI STEREO HEAD PHONES

Deluxe model with slide volume controls. 18-20,000HZ 8 PHMS, $12.95.
Standard model. 20-12,000HZ. 8 OHMS, $4.70.
Sennheiser. HD 414 $22.60.
All are complete with lead and stereo plug.

CAR SPEAKERS

5", 8 ohms, 5 watts. Suitable for radio, cassette or cartridge. Also extension. $7.75 each or $15.00 pair. P.P. 75c.

STEREO RECORD CHANGERS

C129— C141 — C142 — C142A3

Current models, 4 speeds, automatic or manual operation.
Ceramic cartridge, Sapphire stylus. Standard model with 12in turntable $34.00
Deluxe model with 12in turntable, Cueing device, ceramic cartridge, diamond stylus $40.00
Deluxe model as above with adjustable counter balance, 2 spindles, calibrated stylus pressure control added $46.50
Deluxe model as above with 12in Diecast Heavyweight turntable, 4 pole shielded motor, suitable for Magnetic cartridge $56.50

The latter two record changers can be supplied with magnetic cartridge and diamond stylus at $10 extra

MOUNTING PLATFORMS

Pre-cut to suit the above changers and BSR player or blank. 18¼" x 15" x 3½" walnut or teak. $9.00. p.p. 75c

PERSPEX COVERS

Fully moulded, smoke tinted. 17¼" x 13½" x 4½". $9.00. p.p. 60c.

GARRARD STEREO RECORD PLAYER

3 Speeds, Auto-Stop Sonatone HiFi Ceramic Cartridge Included.
$15.50
Pack and Post NSW $1.00.
Pack and Post Interstate $1.50.

STEREO RECORD PLAYER

240V AC · 4 speeds, ceramic cartridge. Separate motor, 7in turntable, pickup arm and rest. Post 50c.

$7.90

Rotating Distress Emergency Beam

Fire Brigades and Rescue squads use them. So do Car, Truck and Boat owners who value their safety. At home on party nights, have a light show. Red, Blue, Amber — visibility ½ mile. 12v D.C. 1 amp operation, waterproof. Complete with heavy duty suction cap. Size 3½" dia. x 5½". $5.75. Pack and post 35c.

15" PIONEER

15in Pioneer low frequency speaker, Imp 8 ohms. Power. 30 watts, RMS designed especially for use with bass guitar or electric organ. Also ideal for stereo woofer speaker
$33.00

MAGNAVOX WIDE RANGE TWIN-CONE SPEAKERS

8 16 ohms
30 16000 Hz.
6WR MK5 12 W RMS $ 9.90
8WR MK5 16 W RMS $10.75
10WR MK5 16 W RMS $11.50
12WR MK5 16 W RMS $12.50
Pack and Post 65c.
Send SAE for Data Sheet.

AMPLIFIERS PUBLIC ADDRESS RANGE 240V-AC

Amplifiers, public address, 240 volt AC. Two Hi-Imp inputs with independent volume controls for mixing either microphones or P.U. Bass/treble tone control.
Available with multi-tapped voice coil matchings (2,3.7,8,15 ohms) OR multi-tapped line matchings (66, 125, 250, 500 ohms). On ordering please indicate impedance matching required. 15 watts RMS. V—C matchings — $49.50
15 watts RMS. Line matchings — $53.50
30 watts RMS. Line — VC — $59.50
40 watt $89.50
60 watt $115.00

P.A. SPEAKERS 8 WATT

8in. units in waterproof projection horns.
15 Ohm voice coils.
Price $16.15
Line output transformers to suit.
$1.75 extra.

ROLA 50 WATTS RMS

(Special purchase)
Model 12U50 12inch

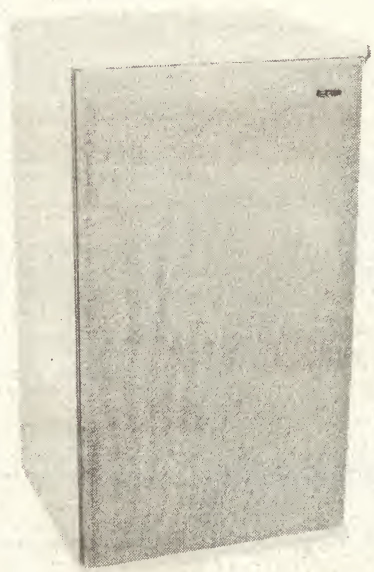
24Hz — 11KHz 8 or 16 ohms
12UX50 12inch hi fi extended frequency

PRODUCT REVIEWS AND RELEASES

B&W DM2 speaker system is smooth

Aimed squarely at the discerning hifi listener, the Bowers and Wilkins model DM2 loudspeaker system is notable for its modern styling and for its extremely smooth frequency response. At $274 it is not a cheap system but it is a good one.

The most recent release in the B & W range, the DM2 system measures 25¼in high, 13¾in wide and 13in deep. As such, it can be elevated on a sturdy shelf or used as an unobtrusive free-standing unit. If required, the distributors can provide a suitably styled pedestal, to raise the woodwork and grille above the danger level from brooms and carpet sweepers.



Constructed from heavy particle board, stiffened and padded internally, the DM2 is quite a heavy unit for its size. However, it is commendably free from panel resonance effects.

Coincidentally, the DM2 utilises the transmission line principle that was the subject of a lengthy article in our July 1972 issue. However, as in all such cases, the performance of the design rests not just in the principle but in the perception with which it has been applied.

The main bass / mid-range drive unit is a robust high compliance type which would be referred to in most company as an 8-inch, having an effective cone and suspension diameter of 7 inches. The rear of the special Bextrene cone is loaded by a vented transmission line formed by partitions within the enclosure, the line being packed with a coarse bonded fibre.

Mated with the main driver is a nominal 2-inch upper mid-range loudspeaker fronted by a perforated cover which presumably acts as an acoustic filter. This is intended to take over above about 2kHz.

For the extreme treble the DM2 is very much in fashion, with a 1-inch dome tweeter.

The loudspeakers and the bottom vent are covered by a cloth grille on a light frame held in place by Velcro style tape.

More than usual attention has been given to the cross-over networks which, all told, involve 6 inductors, 10 polyester dielectric capacitors and 5 resistors

All DM2 loudspeakers are supplied with an individual response curve, taken by automatic equipment in the company's own anechoic chamber. They are normally supplied in matched pairs to ensure maximum symmetry in stereo applications.

The curve for the sample submitted (serial number 458b) is very flat indeed and, if we have seen a better loudspeaker response, we can't call it to mind. Within a 5dB corridor (plus and minus 2.5dB) the curve extends from 46Hz to 19.5kHz.

And that's exactly the way it sounds. The bass is full and smooth at normal listening levels, and needs no artificial assistance from the bass boost circuitry. The middles are uncoloured and the treble sustained without being intrusive.

Intermodulation is also commendably low and, from a Germani recording which we often use to assess performance in this respect, we noted that at all times the small pipes remained clear and unaffected by the heavy pedal notes.

On the debit side, the sensitivity of the system is below average, despite the use of a very large magnet on the main driver. Presumably the designers have opted for a long voice coil and plenty of room for cone movement, in the interests of linearity.

This being the case, the DM2 could not be recommended for use with budget-priced amplifiers having only a few watts of output. On the other hand, this would be a most unlikely combination and one would reasonably expect that anyone purchasing a pair of DM2s would not be thinking of anything less than about 20 watts RMS per channel. In these circumstances differences in loudspeaker sensitivity are really only of academic interest.

It is also perhaps desirable to point out that the DM2 is a fairly compact system as free-standing units go, using a 8-inch driver. While it is capable of giving generous well-balanced sound sufficient for any normal home situation, it could not be pushed to the same power levels that one might expect from a comparably husky 12-inch driver and an enclosure twice the size.

But if the DM2 appeals to you in terms of size, style and price, there is little doubt that you will enjoy the smooth, high quality sound that is available from it.

The DM2 systems are available in a matte white, teak or walnut finish. They are normally sold in matched pairs, the recommended retail price being $550 for the pair.

For further information readers may contact Convoy Imports Division, Convoy International, 1 Maclean St, Woolloomooloo NSW 2011. (W.N.W.).

Sinclair 605 stereo amplifier kit

Agents for Sinclair in Australia, Goldring Engineering (A'sia) Pty Ltd, recently submitted to us a Sinclair Project 605 for evaluation and review. According to the advertisements, it is aimed at "non-technical people who hate soldering irons".

As supplied, the Project 605 comes in an attractive carton, with the power amplifier, distribution and control modules supported and displayed in a foam plastic drawer. Additional items include the control knobs, faceplate, connecting wires and sundry mounting screws and washers. Literature includes a freely illustrated assembly booklet for the project.

It would appear that the Project 605 is intended primarily for installation beneath a plinth accommodating one or other of the popular record players on the market; Garrard and BSR McDonald types are specifically illustrated. With the control knobs exposed through a cut-out in the front of the plinth, the unit should theoretically make up into a compact and useful record player, with full tone control facilities and the compensation and gain necessary to cope with a magnetic stereo cartridge.

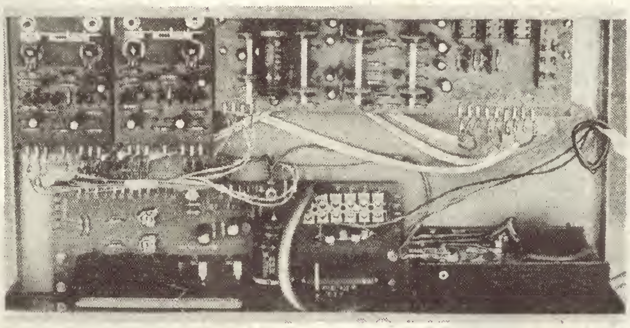
board baseplate. Presumably, the manufacturers have decided that the chances are remote of the system being operated above an equivalent 5W continuous level.

The constructor is warned that he may have to juggle the modules somewhat to minimise hum but that no amplifier can be expected to be completely free from hum if it is "situated within the confines of a turntable plinth." Our own observations suggested that the designers have actually "built in" a source of hum by using as a mains switch a push button which is grouped with the input wiring and switching at the 3mV level.

For our own tests, we elected to assemble the Project 605 modules on metal tray chassis to produce a unit amplifier along the lines illustrated in other Sinclair literature. The chassis measures 13½ x 6½ x 3 inches.

The literature specifically warns against locating the power amplifiers adjacent to the input selector. This makes it more or less mandatory to place the control unit towards the left-hand end of the chassis, with the power modules at the right, as shown in the photograph. Since it was not difficult to do so, we bent up a piece of U-

Illustrated above is the control unit of the 605 kit. On the right is the kit built into a metal tray chassis. Power amplifiers are at top left, "Masterlink" unit below them. Power supply, lower right.



An examination of the kit is likely to produce some misgiving to anyone accustomed to audio componentry, however, in that the tone, volume and balance controls are all of the "tab" variety, completely open, and normally reserved for preset functions. The controls are operated by lengths of suitable rod, which slip through the rotors and receive the control knobs on the front end. In all fairness, while the arrangement looked unpromising, there was no hint of trouble in actual use.

At the same time, the assembly was not above criticism mechanically and, before the controls would rotate smoothly, we had to bend them upright and twist them slightly to prevent binding.

From some of the literature covering the Z.30 power module one would gather that a supplementary heatsink should be provided if they are to be operated above the 5-watt level. However, there is no reference to this in the Project 605 instructions and the Z.30 modules are shown simply bolted to a fibre

channel from 16g aluminium serving to mount the power modules and to provide a generous heat conduction path to chassis.

Placement of the remaining modules posed a problem. If the power supply had been placed behind the amplifier modules it would have been very close to the input connectors and the associated wiring on the "Masterlink" distribution board. The alternative (which we followed) kept the power supply well away from the input sockets but at expense of separation from the input switch. If only the Masterlink board had been laid out with components in the reverse order — almost a mirror image — there would have been no need for such an agonising choice!

Attaching the clip leads posed no great problem, but the amplifier remained dead on one channel until we traced an omission from the distribution board. There was no circuit between connection "A" to one power module and the output coupling capacitor.

(Continued on page 123)

PRODUCTS Plessey "Beta" available complete or as kit

Aiming both at the overseas and the local hifi markets, Plessey Rola Pty Ltd have recently announced a completely new line of loudspeaker systems under the title "Corinth Series." Featured below is one of the series: the "Bėta" which can be purchased complete or built up by the handyman using a loudspeaker baffle kit.

Basically, the Beta system utilises three loudspeakers — a C80 low-resonance 8-inch woofer and two type C3GX cone type tweeters. The tweeters are fed from the input line through a series capacitor. As normally supplied, the nominal impedance of the system is 8 ohms.

Overall dimensions of the Beta enclosure are 25in high, 16½in wide and 11in deep, giving an internal volume of approximately 1.8 cubic feet. The enclosure is of the fully sealed variety.

Two finishes are available — matte teak or walnut, the general styling being deliberately plain, relieved only by a bevel surrounding the grille cloth.

In their leaflet, the manufacturers claim a response from 44Hz to 20kHz, with curve to match. In themselves the figures are inconclusive, since no decibel references are given. However, the curve does show a roll-off below about 65Hz, which is largely what one would expect from a fully sealed enclosure of this general specification.

On listening tests with a variety of program material, the Beta system sounded smooth and free from obvious colouration. There was none of the "forward" quality that comes from excessive middles, nor of the empty, sibilant sound that results from the reverse situation.

At the bass end, the system gave a quite good account of itself with no bass boost from the amplifier, although many might prefer to apply a small amount for good measure. Critical listening against more pretentious (and much more expensive systems) suggested some lack of ultimate weight in the 30-35Hz region.

One significant point was that the efficiency of the system was well up to

average, making it quite suitable for use with amplifiers of limited power output. And it is for use with this type of amplifier that the system is likely to be chosen, in view of its recommended retail price of $79.00 (to which trade discounts apply). At this price level it should have considerable appeal for any enthusiast seeking to buy as much performance as possible for a limited number of dollars.

In point of fact, if the enthusiast can turn his hand to woodwork, there is the opportunity of effecting a further saving by doing his own cabinet work.

With this in view, Plessey Rola are also marketing the kit as pictured, with the three loudspeakers already mounted and wired on the recommended baffle board. The kit includes the coupling capacitor to the tweeters and a potentiometer which allows the level of the tweeters to be adjusted.

Literature is available showing how the enclosure should be constructed and giving dimension details.

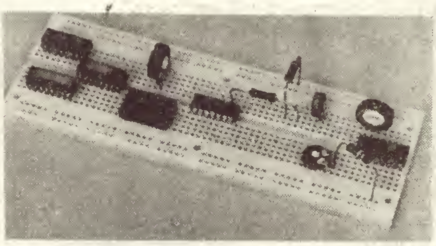
Provided the cabinet work is rigid and airtight, the home-made product should be exactly equivalent in performance to the factory-built Beta. The finish, of course, would be up to the constructor. Recommended retail price for the kit is $28.00.

Further information on these products may be obtained from Audioson International Pty Ltd, 64 Winbourne Rd, Brookvale, NSW 2100; or from Plessey Rola Pty Ltd, The Boulevard, Richmond, Vic 3121. (W.N.W.)

NEW PRODUCTS

Breadboard for IC designers

A wide range of instruments and accessories for electronics circuit and system designers is produced by EL Instruments, Inc of Connecticut, USA, who are represented in this country by General Electronic Services. Pictured is the type SK-10 breadboarding unit, ideal for any designer using ICs.



Anyone who has tried breadboarding even a simple circuit using dual-inline ICs will agree that it is a time consuming operation when carried out in the time-honoured "rat's nest" fashion using soldered joints. Besides the frustration caused by slow progress in getting to the stage where one can actually check circuit operation, there is also the high risk of damaging ICs and other components as the result of repeated soldering and unsoldering operations.

As someone in this category myself, I was very interested to see the SK-10 "EL Socket" breadboarding unit, and try it out. I am happy to report that I found it to be every bit as good as the manufacturer claims. It allows circuits to be connected up very speedily, and with minimum fuss, at the same time causing a minimum of wear and tear to the components. In fact after having used it to breadboard only a couple of IC circuits, I find it difficult to imagine using anything else!

It should certainly be considered almost an essential tool for anyone involved in circuit design using ICs.

The unit is based on a precision moulding of high impact plastic, very similar to nylon in external appearance. Into compartments in the underside of the moulding are fitted nickel-silver spring contact clips, designed to accept most component pigtails, transistor leads and IC pins as well as hookup wire from 22 to 26 gauge. The clips are designed for very low contact resistance, yet require a relatively low insertion force to avoid straining multi-pin ICs and similar components.

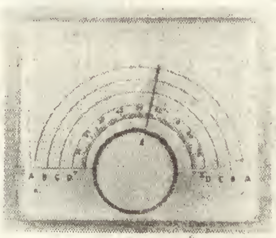
There are two facing rows of 64 clips arrayed along the centre of the SK-10, with standard 0.1in spacing. Each clip is arranged to take up to five wires, component pigtails or IC pins, so that this provides a matrix capable of mounting up to eight 14-pin DIP package ICs, with up to four connections to each pin. Alternatively one can plug in a smaller number of 16 or 24-pin ICs, or a much larger number of discrete transistors, etc.

Along the two longer sides of the unit are eight longer clips, each equivalent to five of the smaller clips, and providing some 25 wire or pin positions. These are intended for power supply lines and bus lines for reset, clock pulses, etc.

The plastic moulding is provided with six countersunk holes to allow the SK-10 to be screwed to either a wooden base board or a metal case. It could thus be used to produce a "breadbox" unit incorporating power supply, indicators and a pulse generator, although EL Instruments also make a number of such units for the designer seeking a more elaborate aid. Trade price of the SK-10 is $22 for 1-9 quantities, and $21 for 10 and up. Enquiries should be directed to General Electronic Services Pty Ltd, at 114 Alexander Street, Crows Nest NSW 2065. (J.R.)

New "Jabel" instrument dials

Watkin Wynne have announced that they have redesigned their popular "Jabel" instrument dials. These now feature a clear polycarbonate front cover which protects the movement and dial from dust, and also improves appearance.



Designed to replace the familiar JB6/1 and JB6/36 dials, which have been used in many "E-A" projects, the new dials have the designations JB6/1N and JB6/36N. Both are larger than their predecessors, measuring 4 x 4.7in (112 x 120mm), although the original mounting screw centres have been retained, to enable easy replacement where this may be desired.

The polycarbonate cover of the new dials may be snapped off after removal of the control knob, allowing ready access to the scale for calibration of logging. The construction is very similar to that of many modern meter movements, and in fact the proportions of the dial are such that it would provide a good match for meters on an instrument front panel.

Proposed prices for the new dials are $4.80 for the JB6/1N (6:1 drive ratio) and $6.00 for the JB6/36N (36:1 and 6:1 dual ratio), not including sales tax. Enquires should be directed to normal trade suppliers, who can order from Watkin Wynne Pty Ltd at 32 Falcon Street, Crows Nest.

NEW RANGE OF RESISTORS CONDENSERS AND POTENTIOMETERS

CARBON RESISTORS

Current type resistors by Philips, IRC, Ducon & Morganite in a wide range of values from 100 ohms to 10 meg. ½ and 1 watt

$1.50 per 100 Post 30c Extra

MIXED CONDENSERS

The condensers are in most popular brands and include polyester, paper, mica ceramic and electrolytic on values to 8mfd.

$1.50 per 100 **Post 50c extra**

CERAMIC CONDENSERS & THERMISTORS

A large range of current disc & tube ceramic condensers & thermistors.

$1.50 per 100 **Post 30c extra**

POTENTIOMETERS

The pots are all current types and include switch pots, standard pots, pre-set etc.

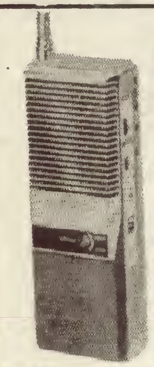
$1.50 per doz. **Post 50c extra**

REGRET SPECIAL VALUES IN RESISTORS, POTS, & CONDENSERS CANNOT BE SUPPLIED.

NEW BATTERY OPERATED BURGLAR OR DOOR ALARMS AT HALF PRICE

These alarms operate on two 1½v batteries which are supplied and are suitable for mounting on doors, windows, drawers etc and give a very loud signal when set off.

$1.95 Post 25c



At last a breakthrough in the cost for high quality portable radio transceivers of the walkie-talkie hand-held type. We are introducing and offering for sale a fully PMG approved Transceiver.

MIDLAND 1 WATT TRANSCEIVER

for 27,240 KHz operation with switch provision for two additional channels, tone call signal, background noise squelch control, battery voltage indicator, steel case with separate cover, good for five miles distance communication under average field conditions, with penlite cell-batteries for **ONLY $39.95 PER UNIT, FULLY GUARANTEED.**

Post & Packing **$1.50** extra (Reg. Post)

MAGNAVOX WIDE RANGE TWIN CONE SPEAKERS

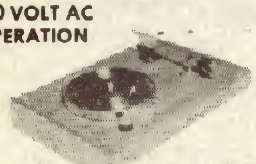
8 on 16 ohms VC. Post and packing **65c**

6WR MK V 12 Watts RMS **$9.90**
8WR MK V16 Watts RMS **$10.75**
10WR MK V 16 Watts RMS **$11.50**
12WR MK V 16 Watts RMS **$12.50**
8-30. 30 Watts RMS **$18.50**
3TC Tweeters **$3.75**

SPEAKER SPECIAL
Imported Tesla 8" Speakers. 8 ohm imp. **$4.75.**
Post and Packing 65c.

NEW IMPORTED STEREO TURNTABLE AND PICK-UP

240 VOLT AC OPERATION



3 speed turntable with ceramic stereo pickup counter-balanced tubular arm, **$7.90.** Base in teak or walnut, **$6.50** extra. De luxe base **$8.50** Post 50c or $1.00 with base.

Turntable and motor separate **$4.50**

21 WATT P. A. AMPLIFIER — MIXER

As featured in June issue Electronics-Aust.

complete kit of parts. Post Extra

$57.00

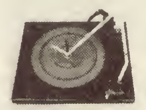
Wired & Tested $10.00 extra

NEW COLUMN SPEAKERS

Suitable for above Amplifier in walnut finished cabinet containing four 8" Rola Speakers Imp. 8 ohms.

$37.50 **REGRET NO MAIL ORDERS**

NEW GARRARD RECORD CHANGERS MODEL 1205



4-speed manual or automatic operation fitted with Garrard Crystal Pick-up. **$25.00**

Post & Packing **$2.50** extra (Reg. Post)

NEW GARRARD RECORD PLAYER

Three speed turntable with "Sonatone" ceramic pick-up mounted on grey metal base plate with automatic stop.

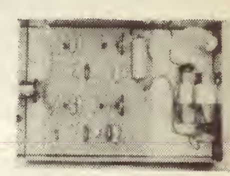
$15.50 Post and packing NSW — $1.00; Interstate — $1.50.

PHILIPS VALVE & PICTURE TUBE DATA BOOKS

hard covered book of over 500 pages covering all modern valves & picture tubes. List price $4.75 — Special **$1.75**

A TRANSISTOR PREAMP FOR MAGNETIC PICKUP OR TAPE HEAD (Stereo)

Using 2 transistors per channel, as featured in "Electronics Australia" (Sept. 1971). Complete kit includes transistors, PC board, resistors, capacitors.
Circuit and full details supplied.
Kit (not incl. box) **$7.90**
240V Power Supply **$4.50**
Metal box **$2.75** extra
State if required for pick or tape head.



NEW LOW COST STEREO SYSTEM

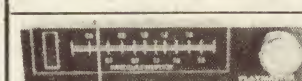
AS FEATURED IN JAN. ELECTRONICS AUSTRALIA

Complete kit of parts including "Garrard" record player with auto. stop and crystal pick-up. Magnavox 8WR or 6WR wide range twin coned speakers. (Cabinets not supplied). Amplifier only, less speakers and player, **$32.00**

$69.50 Post and packing $2.50 extra.

POLYESTER CAPACITORS

Pack of 100 new polyester capacitors .001 to 0.1 in 160, 250 and 400 volts working. **$3.50** Plus 50c Post and Packing



BROADCAST TUNER KIT

$22.50

Post 75c

Complete kit of parts including dial mechanism and zener diode for this I.C. tuner as featured in Feb. 71 E.A.

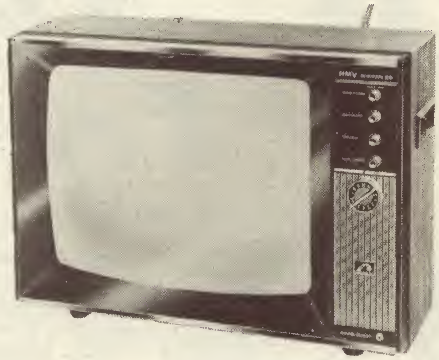
NATIONAL RADIO SUPPLIES

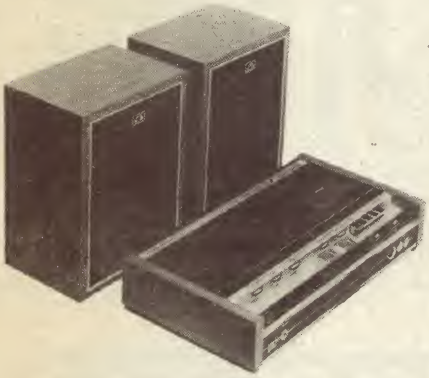
332 Parramatta Road, Stanmore, NSW 2048 Phone 56 7398

Transportable TV & Cassette Recorder from EMI

The new HMV "Nipper 20" PX-E5 transportable TV from EMI Ltd is a hybrid design which should appeal particularly to servicemen. Valves are used for the high dissipation stages, with transistors and an IC in low-level stages. The circuitry is on easily accessible board modules on a "drop down" chasis.

Features include noise cancelling, automatic black level control, a four-stage IF strip and a solid state EHT rectifier.





The HMV "Triton" TK-42 three piece cassette recorder features a built-in radio whose tuning range extends to cover university radio stations. It comes complete with microphone and demonstration tape.

Enquiries for both EMI products should be directed to normal trade and retail outlets.

Ferguson transformer for Supply/Modulator

In the article describing the Power Supply / Series Modulator, published in the September issue, it was mentioned that Ferguson Transformers Pty Ltd were producing a new power transformer for the project — the type PF3544. Since the original article was written, Ferguson Transformers have kindly submitted a sample of the PF3544 transformer to us for evaluation.

Wired into the prototype supply / modulator, the sample transformer gave excellent regulation. In fact the performance was in every way equal to that obtained with the salvaged 300mA transformer originally used.

The PF3544 may therefore be fully endorsed for use in the project, and would be a good choice for those either wishing to use a new transformer instead of a salvaged unit, or unable to obtain a suitable used transformer. It may be obtained on order through normal trade suppliers, from Ferguson Transformers Pty Ltd, at 331 High Street, Chatswood, NSW, or their agents in each state. (J.R.)

WALKIE TALKIE

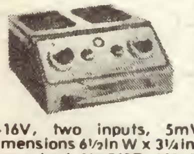
Scoop buy

MAIL ORDER SPECIAL
Limited quantity only

- PONY CB 16. ·1 WATT
- 9 TRANSISTOR
- SUPERHET
- METAL CASE
- P.M.G. APPROVED
- BATTERY METER
- XTAL RX & TX

ONLY **23.95** EACH Plus 5c Post

PETER SHALLEY Electronics Pty. Ltd.
127 YORK STREET, SYDNEY
Phone 29-3767 — 29-7021

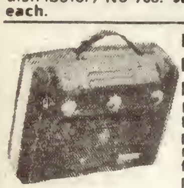


New All Silicon 30 / 60W PA PORTABLE AMPLIFIER

12-16V, two inputs, 5mV and 100mV. Dimensions 6½in W x 3¼in H x 8½in D. 15-ohm output, No 763D, $62. For 125, 250, 500-ohm output, No 763A, $64. For 240V operation $33 extra.
10W PA amplifier similar to above, 4-ohm output, 240V operation, No 729D, $40. Freight extra.

CD IGNITION COIL

For EA (Fraser) circuit. Mounted on strong fibreglass printed circuit coded for all other components. Polyester film layer insulation. Connected and tested. For standard distributor, No 787; for photo cell distributor, No 786. **$8 each. Postage 20c each.**



R.C.S. COMPLETE DO-IT-YOURSELF KITS

Peak reception. Low price. No expensive test equipment. Everything fits. 1964 RF Transporta 7.

Complete kit — No 640 $43.50
Portable car radio. Identical to 640 above, plus extra switch and car coil, etc. No. 642 $46.00
Postage $1.
(Write for booklet on 640 and 642.)

NEW TRANSISTOR PREAMP KIT

SIZE 3 x 2 x 1in, 2 req. for stereo.

LOW IMP input, 2 trans, 672C	$4.50
Wired ready for use, 672D	$8.00
HIGH IMP, 2 trans, 680C	$6.50
Wired ready for use, 680D	$8.00
HIGH IMP silicon, 3 trans, 682C	$8.00
Wired ready for use, 682D	$9.50

Postage 10c each. Write for data.

COILS and IFs 455KHz

Aerial, RF, Osc and IFs	$2.00
Ferrite aerial	$2.40
No. 265 Universal tape Osc coil	$6.00

Postage 10c. Write for details and price.

ALL PRINTED CIRCUITS SINCE 1960 now available

Clearly coded for easy assembly. Accurate to size. With parts list. Immediate despatch.
- Accurately machine printed and etched.
- Specials to your drawing.
- Phenolic or fibreglass — gold or tin plated.
- Special manufacturers packs of 10.
- Order direct or write for blueprints list.
- Add 20c postage.

All printed circuits for EA, R & H, ET, Philips and Mullard projects available.

LATEST P.C's

		834 ET026	801 Philips
831 EA 72/P3	827 ET021	795 ET025	$2.80 ea
829 EA 72/T2D	828 ET023	$2.50 ea	806 EA 72/A6 $2.30
805 EA 72/P6	830 EA 72/R2	835 EA 72/T3	800 ET 034 $2.60
$2.00 ea	832 EA 71/A8	836 EA 72/MX6	808 EA 72/C2 $3.50

HI-FI BROADCAST TUNER UNIT 4 TRANSISTORS—HIGH SENSITIVITY

RF, mixer, IF power detector. Adjustable aerial coupling with 461 Dial, knobs, switch pot and whistle filter. Can be altered to 8, 9, 10 or 11 KHz. Complete as illustrated no. 474D, $35 + Freight $1.

10W STEREO
MULLARD
10 + 10W RMS

With output transistor PROTECTION. Frequency response 40Hz to 30KHz. Distortion 0.5 per cent. Treble, bass boost, 20dB.

Complete kit of parts, No. 480C	$74.00
Wired and tested, No. 480D	$79.00
Cabinet as illustrated	extra $10.00
Magnetic pickup preamp, No. 762D	extra $11.50
Inbuilt BC tuner with w/filter	extra $35.00

Plus freight. Write for brochure. For special Saturday demo, ring 59 6550.

TRANSFORMER

Tap 6V and 9V at 100mA. Filter capacitors, rectifier, resistor, etc. $6.50. Post 20c.

NEW STEREO MAGNETIC PRE-AMP

Hum free, 5mV input, 250mV out. Size 3 in x 2in x 1in. Wired ready for use. No. 762D. $11.50. Post 10c.

NOISE FILTER
for radio and TV

No. 27 line filter, 2A	$8.50
No. 29, 10A. No. 29B, 20A line filter	$35
No. 30 pulse filter, 2A	$11.50
No. 11 aerial filter	$13

Order direct. Pack and post 50c.

MAGNETIC STEREO PRE—AMP

In 5mV, out 250mV. Bass and treble 20dB

No. 724C	$29
Wired ready for use	$31

Postage 30c each.

For crystal, ceramic, No. 722D	$27

NEW BASS BOOST
4-TRANSISTOR STEREO AMP

Unity Gain:
400Hz, 0dB
100Hz, 5dB
50Hz, 9dB
30Hz, 14dB

Connect between your preamp and main amp No. 791D, $10.80. Postage 20c.

LATEST PRINTED CIRCUITS

779—70.R.D.1	$3.00
780—70.P.A.1	$3.00
790—70.H.P. 1	$3.00
783—71.T.U.2	$2.00
766—773—789—71.R.1	$2 ea

WHISTLE FILTERS

Part No. 128, 8KC TOPCUT	$4
Part No. 129, 10KC NOTCH	$5

Plus 20c Post.

R.C.S. Order by mail. Cheque or Money Order (add postage) direct to:—
RADIO PTY. LTD., 651 FOREST ROAD, BEXLEY, N.S.W. 2207. 587 3491

NEW SONY AUDIO EQUIPMENT

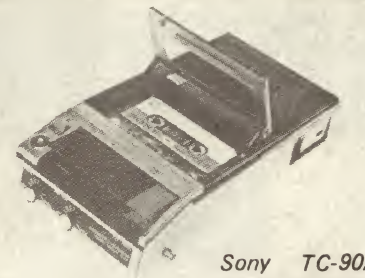
NEW SONY EQUIPMENT. Recent additions to the Sony range of audio and radio equipment have been announced by Jacoby Kempthorne. These are:

Model TC-165 cassette tape deck. This automatic-reverse deck has closed-loop dual-capstan drive system which permits optimum tape tension and tape-to-head contacts to cut down wow and flutter and modulation noise. Controls allow either automatic or manual reverse, repeat or stop. A limiter circuit prevents over-modulation. Either standard or chromium-dioxide tape can be used. Recommended retail price is $352.

Model TC-133CS compact stereo cassette recorder. Features: 15 W output; 4-track stereo or 2-track mono recording and playback; two-part lid holds loud-speakers; cassette rack to hold six cassettes; tape selector for chromium-dioxide or standard tape; two record level meters. Recommended retail price $256.

Model TC-90A compact cassette recorder. Features: Inbuilt eletret condensor microphone; automatic shut-off mechanism at tape end; cue keys, which allow fast forward or rewind while listening for tape cues. Recommended retail price $119.

Model TC-95A is a new version of a popular cassette recorder with review and cue keys which allows the user to locate items on a tape, now fitted with the additional facility of automatic shut-off at the end of the tape. Recommended retail price $142.



Sony TC-90A compact cassette recorder

Sony TC-95A cassette recorder

Mallory mercury and alkaline cells, and recording tapes are now distributed by Industrial & Medical Electronic Co, as also are Evercast antennascopes and reflectometers.

Industrial & Medical Electronic Co, 288 Little Collins Street, Melbourne, 3000.

Radio signal booster, the "Tranimate", has been specifically designed to adapt ordinary transistor portable radios to give car radio performance, by eliminating the major problems of ignition noise and fading signals. It is a fully shielded 2-stage transistor booster amplifier which connects to any standard car aerial and can be mounted under-dash or in any other convenient location in a car. The Tranimate is tuned to a wanted station by a handspan dial. It amplifies the incoming signal and feeds it to an induction device which is attached to the outer case of any portable radio. There is no direct electrical connection to the set.

Ferris Products Division, Hawker Siddeley Electronics Ltd, 752 Pittwater Road, Brookvale, NSW 2100.

Parametric amplifier, model 1702, can be used in circuits where extremes in low error currents, low current noise, high input impedance, high common mode voltage, and high common mode rejection ratio are critical design requirements. Manufactured by Teledyne Philbrick, USA, the 1702 uses a number of proprietary developments in circuit design and packaging for an exceptionally low bias current of 2fA (.002pA). Other features include: output frequency response 40Hz minimum; common mode voltage 100V; common mode rejection ratio 100,000; offset voltage drift 10uV / C max. The unit is totally enclosed in a metal cup measuring 1.5in square x 0.6in high (38 x 38 x 17mm), and is epoxy encapsulated for reliability.

Elmeasco Instruments Pty Ltd, PO Box 334, Brookvale, NSW 2100.

Sweep generator, model 610C, features new detector and marker options with a combination cabinet-rack package only 7in (178mm) high and under 12lb (5.5kg) weight. Manufactured by Wiltron Company, USA, the solid-state instrument offers a broader range of plug-ins than other sweepers in the Wiltron range, covering from 100kHz to 18GHz in user-oriented frequency bands. Plug-ins for specific applications include: CATV; HF, VHF and UHF communications; Racan; radar; microwave communications; and ECM models. Main frame features include: Birdie bypass type filter comb and fixed frequency markers, variable frequency markers presented as RF or video pips or as an intensity dot.

Jacoby, Mitchell & Co Pty Ltd, PO Box 2009, North Parramatta, NSW 2151.

Video equipment, manufactured by Viscount Video Systems Ltd, Candada, caters for applications ranging from CATV, educational and industrial training facilities to small broadcast studios or outside broadcast vans. A wide range of colour or monochrome video mixers, effects generators, routing switches and programmers are built to PAL colour standards and offer quality performance at economic prices. The units use "Isoswitch" crosspoints for vertical interval switching.

AWA Rediffusion Pty Ltd, PO Box 96, North Ryde, NSW 2113.

People in Industry

GEORGE KENT (ANZ) PTY LTD has appointed Mr John F. Harrison a director of the company and manager of the Victorian division. Mr Geoff Keys has been appointed manager of the NSW division. He was previously manager of the Systems division which was merged with the NSW division.

HAWKER SIDDELEY ELECTRONICS LTD has appointed Mr Ted Allen products manager for Channel Master TV aerials and MATV systems. He has been with the company since commencing as a member of the design and development staff in 1971.

RIGHT: Mr Ted Allen, of Channel Master.

BELOW: Mr John F. Harrison, (left) and Mr Geoff Keys (right) of George Kent (ANZ) Pty Ltd.

TUDOR RADIO

L. E. CHAPMAN ESTABLISHED 1940

103 ENMORE ROAD, ENMORE, NSW 2042.

PHONE 51 1011 NEW POSTAGE RATES PLEASE ADD EXTRA

RECORD LEVEL INDICATOR METERS
$1.50

WE STOCK THE COMPLETE RANGE OF MSP SPEAKERS

SPEAKERS

MSP 8-inch dual-cone	$7.50
MSP 12-inch dual-cone	$9.50
MSP 7 x 5	$5.00
MSP dual-cone 6-inch	$7.50
Rola 6 x 4	$3.50
Rola 5 x 3, 15 or 27-ohm	$2.50
MSP 6 x 9, 8 or 15-ohm	$6.00
National hi-fi built in tweeter 8-ohm	$14.00
Peak dual-cone	$7.50
MSP 12-inch radial beam 12PQB	$25.00
Mid range 8 inch woofer 4-ohm	$6.00
MSP 5 / inch large magnet 15-ohm	$3.00
MSP 4 / inch large magnet 15-ohm	$3.00
Magnavox 6 x 9. 27-ohm	$5.00
MSP 6 x 4,8-ohm	$3.50
Rola 4-inch 27-ohm	$3.00
MSP 4¼ x 2¾ 8-ohm	$2.50
MSP 6 x 5 15-ohm	$2.00
Magnavox Tweeter 5-inch HF5SIC	$7.50
Rola custom speaker Kit C3 GX tweeter and C60 woofer and all components	$19.05
MSP 15-inch	$45.00
MSP dual-cone 12 aux 2 015-watt RMS	$17.50
Pioneer 15-inch 30-watt RMS	$40.00
Magnavox Electrostatic 3½-inch tweeter Md1 3.5	$2.50
Tesla 8-inch 4-ohm	$5.00
Rola 8-inch 15-ohm	$5.00
8-inch 3-ohm	$4.50
Magnavox 3TC tweeters	$4.00
Magnavox 8WR	
Magnavox 12WR	
Magnavox 8-30, 8-ohm	
MSP 6-inch 15 ohm	$4.00
MSP 5-inch tweeters	$3.50
MSP 2¼-inch	$2.50
MSP 2½-inch	$2.50
MSP 2¾-inch	$2.50
Speaker Plugs, 4 pin	15 cents
Speaker Sockets	15 cents

SPEAKERS
3½-inch 45-ohm
$3.50

Hitachi 2SB337 Power Diodes **$1.50**

RECORD CHANGER: DUAL 12-10. Shielded motor **$58.00**

PHILIPS GRAMOPHONE MOTOR.
6 volts, 4-speed, and pick-up $7.75.

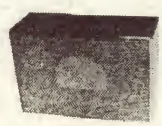
B.S.R.CERAMIC CARTRIDGE STEREO **$4**

B.S.R. RECORD CHANGERS
latest models, G11301 balanced arm, shielded motor, heavy turntable, magnetic cartridge **$55**
C117 magnetic cartridge **$45**
UA15 with 12 inch turntable **$30**

B.S.R. MINI CHANGER
UA50 **$19.50.**

SPEAKER CABINET

size 16 x 8 x 10¼ inches complete with 8 tacx MSP dual cone speaker, 5 inch tweeter and crossover capacitor, **$21.50**
Cabinet without speakers **$10.00**



Speaker Cabinet
10 x 7 x 4 with 5 inch speaker **$5.50**

SPEAKER CABINET, size 19 x 15 x 9. Suit 12-inch and 3-inch tweeter. **$12.50**

AMPLIFIERS, 3½ watts, size 7½ x 5 x 4½ **$10**

SPECIAL
25 different values. Mixed pots for **$5**

Special perspex tops for record changers **$4.75**

BATTERY SAVER,
6 or 9 volt DC 300MA, **$11.00**

PHILIPS PLUG-IN PICK-UP CART-RIDGE, mono **$3.50**

B.S.R. 4 speed Gramo Motor and Pickup. 240 volt with built in 9 volt power supply **$7.95**

250 mixed screws. BA, Whit., self-tapper bolts, nuts, etc. **$1** bag plus 25c post.

6.5mm jack plug & 7ft shielded cable 95c

6.5 mm to 3.5mm plug adaptor & 7ft shielded cable 95c

3.5mm to 3.5mm connector, 7ft shielded cable **95c**

Jack plug sockets, 6.5mm **35c**

POTS

1 meg. 2 pole switch	95c
100K switch 2 pole log	50c
10K carbon or wire wound	50c
1.5 linear	50c
½meg log	50c
250 Dual Ganged Log Pots	$1.25
20K switch	75c
10K switch	75c
1.5 dual ganged log	$1.00
2 meg Dual Ganged Lin.	$1.25
Dual 3 meg ganged log	$1.00
500 ohm WW	50c
50K Lin	50c
15K T5K	50c
10K Dual ganged concentric	50c
2 meg log 2 pol	$1.25
7,500 log	50c
200K lin	50c
250K log	50c
2K lin slotted	25c
50ohm	50c
250K lin	50c
100K lin	50c
½meg lin	50c
50 log switch	75c
1 meg dual ganged log	$1.25
2 meg lin	50c
10K dual-concentric double-pole switch pots	$1.25
Mixed pots, 25 different values	$5.00

50-ohm POTS ideal for Ext. Speakers. 50c each

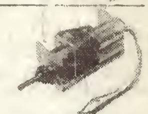
POTS

1 meg. Dual Ganged Log	1.25
1 meg. Dual Ganged Lin	1.25
½ meg. Switch Pot double pole log	75c

Dual concentric double pole switch pot 50k, 25k **$1 each**

CAR RADIO PUSH BUTTON TUNER COMPLETE
$4.50

FERRITE TUNERS
$1.50



SPEAKER ENCLOSURE size 19 x 15 x 9 inches. Complete with two 8 x 4 speakers and 3-inch tweeter, including cross-over network, in 8 or 15-ohm **$25**

Morganite and IRC resistors. At least 33 values. Suit transistors, radios, TV etc., **$2.00** per 100. Pack and post. **25c.**
100 mixed condensers, micas, ceramics, tubular. Fresh stock.
$2.00. Pack and post 25c.
50 + 24, 350vw + 100uF 25vw, 75c each
30 + 30 300VW 250VP 75c each
Many others. Invaluable for service.

AMATEUR BAND NEWS AND NOTES

by Pierce Healy, VK2APQ

Changes Proposed for Two Metre Band

The allocation of simplex and repeater channels within the 144-148MHz band has been discussed at considerable length by Australian VHF operators in recent months. A vital decision, about to be made, will affect all those who use this band.

The acceptance at the ITU Space Frequency Conference (Geneva 1971) of an Amateur Satellite Service, has raised several problems in the allocation, on a gentlemen's agreement basis, of channel frequencies in the 144MHz to 148MHz band in Australia. One of the problems arises from the fact that the universal two-metre band extends from 144 - 146MHz, but in some countries as in Australia extends to 148MHz.

In the past, amateur satellite frequencies have been set within the 145.85MHz to 146.00MHz portion of the universal frequency allocation. It is now conceivable that more elaborate amateur satellites will be placed in orbit in the foreseeable future. Therefore, to obtain the greatest benefit and service from orbiting or synchronous repeater or translator installations, channels clear from possible interference from or to ground based stations is necessary.

The current discussion centres around proposed changes to simplex and repeater channels already in use in Australia. The repeater channels were agreed to following a WIA sponsored meeting held at Wodonga, Victoria, in September 1968. This was shortly after the PMG's Department had approved the operation of 2 metre band repeaters.

The frequencies agreed to at the Wodonga meeting were:

Channel 1 Input 146.1MHz Output 145.6MHz
Channel 2 Input 146.2MHz Output 145.7MHz
Channel 3 Input 146.3MHz Output 146.8MHz
Channel 4 Input 146.4MHz Output 145.9MHz

In addition, there are three simplex channels currently in use, as follows:

Channel A 145.854MHz
Channel B 146.000MHz
Channel C 146.146MHz

At a meeting held at Albury, NSW in July 1972, it was recommended that the output frequencies of all repeaters be changed to 600KHz above the input frequencies and that an additional three channels be established on 50KHz spots around the existing channels. The table being:—

Channel	1	Input	146.1MHz	Output	146.7MHz
"		"	146.15MHz	"	146.75MHz
"	2	"	146.2MHz	"	146.8MHz
"		"	146.25MHz	"	146.85MHz
"	3	"	146.3MHz	"	146.9MHz
"		"	146.35MHz	"	146.95MHz
"	4	"	146.4MHz	"	147.0MHz

It was also recommended that frequencies:

146.45MHz
146.5MHz
146.55MHz
146.6MHz
146.65MHz

be adopted as national FM simplex net frequencies and that 146.5MHz be adopted as the national FM net calling frequency in lieu of 146.0MHz.

It was recommended that these changes be implemented as from November 1st, 1972.

The Albury meeting was called to consider proposals initiated by the Victorian Division that existing FM repeater and simplex frequencies be changed to prevent a clash with frequencies allocated to international amateur satellites.

The choice of amateur satellite frequencies is dependent on such precautionary measures as non-interference to other services whether orbiting or land based. Also non-interference to equipment contained in the same package.

Many claims, expressing opposing opinions as to the necessity for making changes in the present structure, have appeared in various club newsletters or have been expressed over the air. These appear to be based on such aspects as: lack of foresight at the Wodonga meeting; the congestion that exists on repeater nets in Victoria; the cost the change would be to individuals; traditional opposition to any change; minor technical problems with equipment; and others of like character.

Some, at least, of these reasons could well be valid ones, particularly those concerning cost to individuals. One crystal would need to be changed for each repeater channel, and two for each simplex channel.

However, whatever reasons may be put forward, the actual use to which amateur satellites should be put or how many operators will be able to use satellites as a means of communication, seem to have been completely overlooked or given little publicity. Remembering that only four years have passed since the first attempt was made towards standardisation of repeater channels was made at Wodonga, could it not be that, within the next few years, new problems will be revealed due to lack of foresight at the Albury meeting?

To minimise possible problems in the future and to assist in overall band planning, a more logical approach to the current situation would be for those interested to transfer their efforts and energies, through the International Amateur Radio Union, towards world wide policy agreements on such aspects as:

a. specific purpose for which amateur satellites will be used ie.

— amateur communication
— service to the community

b. world wide agreement on satellite down link channels within the international 144MHz band;

— on a regional basis
— group of call areas
— communication mode
— standards of operation to be observed.

These are not just idle thoughts but based on the outlook expressed by many experienced amateurs. The most recent to come to notice are those of A. Prose Walker, W4BW, Chief of the Amateur and Citizens Division, FCC, when addressing an Old Timers Banquet of the Quarter Century Wireless Association on 11th March 1972. A report appeared in the June 1972 issue of "CQ". As some of the points made apply to the future of amateur satellites, they are given in the following extracts.

Referring to future amateur satellites "One of the major objectives is that it be available over a long period of time; not just a month or 6 weeks, but a period of several years .... available to all amateurs of the world at one time or another ..... a near-geostationary satellite; one which slowly drifts around the world remaining available for periods of weeks or even months to amateurs in any particular hemisphere.

"....... not a toy but a 'professional' amateur communication satellite, the limitations of which are only those imposed by cost and the decision to put it into orbit.

"The operating frequencies probably should be as high as possible without ruling out general participation by amateurs. Let's choose a satellite with an up link frequency in the 435-438MHz band and the down link in the 144-146MHz band.

"The choice of these frequencies is probably rather good because on 435-438MHz, remember, the ITU has told us that we must have the capability of eliminating potential interference to other shared services in that band. Obviously, it is easier to prevent interference from the ground than on a satellite. On the ground we can realise substantial antenna gain at that frequency. This could be done on the satellite, but there are other aspects to consider."

After discussing the technical requirements of such a satellite with a power output of 20 watts:

"We now have a satellite about the equivalent in physical size to the original Early Bird.

"One of the greatest problems that amateurs will have to face and overcome, is the necessary discipline to maximise use of the satellite. Our postulated satellite can handle about 20 QSO's simultaneously, depending on exact values of band width and power output. But this capability will be realised only if all participants observe self discipline concerning their EIRP (Effective Isotropic Radiated Power).

"If some amateurs appropiate more than their fair share of the available power through the satellite, it will leave less for others trying to use the system. Another important aspect of discipline will be listening on the down-link frequency to make sure that the proposed channel is clear in both directions. If this discipline breaks down, the result will be not only QRM in the ordinary sense, but also cross-modulation among signals of unequal power in the satellite receiver and thus lower signal / noise ratio for everyone using the satellite.

"By now you probably have concluded that all is not as simple as picking up your telephone."

Referring to the best way to use bandwidth and the use of various modes the comments were:

"But in the satellite case, there has to be world-wide adherence to the disciplines into the system, or the satellite will not function to greatest advantage.

"Up to now we have covered the satellite itself, what it could do and the limitations that may be imposed. But to what purpose do we put it? If we are able to convince others that such a satellite is worth the investment, surely there must be some useful purpose. I would not suggest that we should never use it for some or all of the purposes that have been mentioned such as a 'satellite DXCC' a 'satellite WAS' an 'all OSCAR BPL' or perhaps just rag chewing, but I have a feeling that these things by themselves will not justify such a satellite.

"It seems to me that one of the greatest uses of such a satellite can and probably should be for educational purposes, not only to train our own young people in the techniques of satellite communication, but also others around the world.

"The so-called 'new and developing' countries of the world have not yet reached an acceptance of amateur radio as a worthwhile utilization of the radio spectrum. Perhaps if they see a benefit such as this, it would impress them with the tremendous promise that amateur radio can have for them in the development of trained people in telecommunication. In the plenaries of the ITU I can assure you, we need their support."

After commenting on the ITU proposals for emergency communications (see April 1972 issue of these notes); several questions were asked.

".... are we just little boys playing in our basements as we have often been referred to in the assemblies of the ITU?

"Are we content to become fragmented among ourselves, arguing like spoiled children about who should occupy what portions of our HF or even VHF, now that we have finally started to earnestly occupy them?

"Are we fundamentally just a bunch of hobbyists who would idly chatter incessantly over our transmitters which occupy precious spectrum space?

"What is our responsiblity to future generations who will some day inhabit 'our bands' when you and I are 'silent keys'? Are we leaving them a legacy for the future based on sound judgement and planning?"

There is much food for thought in Prose Walker's address, coming as it does from an amateur closely associated with world opinion on radio communication.

The full text of the address is recommended reading for all interested in amateur satellite communication.

A valid opinion being expressed by a large number of amateurs is that the federal council and the executive of the WIA should now, through the Region III Association, be leading the way towards consolidation of the amateur satellite service on an international basis, rather than encouraging minority parochial differences of opinion on subjects that are no real threat to the future of amateur radio.

And, above all, let the Australian amateur know what is being done in that regard.

Radio clubs and other organisations, as well as individual amateur operators, are cordially invited to submit news and notes of their activities for inclusion in these columns. Photographs will be published when of sufficient general interest, and where space permits. All material should be sent direct to Pierce Healy at 69 Taylor Street, Bankstown, NSW 2200.

WIRELESS INSTITUTE ACTIVITIES

1972 REMEMBERANCE DAY CONTEST

Comments heard suggest that the 1972 "RD Contest" was very successful, with a number of high scores being made. Band conditions in general were good and the participation by New Zealand operators appeared to be higher than in 1971. As is usual the contest gives all Australian amateurs the opportunity to exchange greetings with each other. It is true to say that more Australian operators take part in this event than any other single amateur radio contest.

The opening address was given by Max Hull VK3ZS, past federal president and honorary life member of the WIA. This was the 25th anniversary of the contest and Max outlined the history of the contest since its inception.

"This year's event is a conspicuous one, celebrating as it does the contest's silver anniversary, and so, as a member of the historical section of the federal council of the WIA, it gives me great pleasure to have been asked to say a few words before opening the contest officially.

"Although the inaugural contest was held in 1948, 25 years ago, the idea was born in 1947 in a motion brought before the federal council by the Queensland delegate attending the annual federal convention held in Melbourne. In the following year rules were drawn up by the late Bill Mitchell, VK3UM, a trophy was designed and subsequently manufactured by George Glover, VK3AG, and the perpetual date of the weekend nearest to the 15th August set aside as the period for the contest each year, representing the weekend nearest to "D" day.

"Because the contest was decreed in memory of the licensed amateurs who gave their lives in defence of their country, it was aptly named the Remembrance Day Contest and the call signs of those who died that we may live are permently engraved upon the perpetual trophy which bears the name of the contest. The trophy itself is held by the division winning the contest each year."

Max went on to discuss the comradeship which the team effort of the contest had fostered and how this emulated the national and international goodwill which amateur radio creates around the world. He also spoke on the custom of presenting an opening address by some notable person in the community, a practice established by the Institute in 1957. In listing the names of those persons who had given their time to perform this task, he emphasised that their readiness to do this was a tribute to the Institute and the amateur movement as a whole.

His closing comments were:

"One has only to look at world affairs with unclouded mind and untinted glasses to observe the technological achievements of countries in which the government of the day encouraged amateur radio transmitting and are signatories to the preservation of amateur frequency bands for licensed amateur operators when they represent their country at international radio conferences.

"But even within some countries the demand for frequency assignments grows greater every year. Therefore, priorities are born overnight which can and in the future will be a constant source of danger to the preservation of the amateur service.

"For this reason it seems an appropiate occasion to ask of all amateurs that they realise the problems that will always lie ahead and the urgency of having a strong enough national organisation to cope with the future problems, to encourage eminent people such as the aforementioned to become aware of the amateur service, if they are not already aware of it, and what the service does around the world.

"In handling the communications of the countries in which it exists; the raising of a trained body of experts; in time of emergency being a partly trained body of people of use to the defence forces in time of war and in general being a technical service capable of training people in electronics skills for the national interest.

"All this can be lost forever if for one single moment the amateur service around the world relaxes its vigilant activities. The only way it can maintain its vigil is by a strong and active national amateur organisation as we have in Australia and which is also enjoyed in New Zealand, Japan, USA, United Kingdom and other European areas. The only way it will be strong is to have a high membership strength and strong leadership.

"With the support of every licensed amateur in Australia the Wireless Institute of Australia can maintain its strong advancement over the years to secure the continuation of the amateur service. The existence of which we can thank the hundreds of people who have given freely of their time, including those whose memory we revere by the conduct of the Remembrance Day Contest over this weekend.

"And so with these last few remarks we welcome the participation in the 1972 contest of operators around the Commonwealth and Mandated Territories and over in our sister country New Zealand.

"The federal council of the Wireless Institute of Australia wishes all participants good luck and officially on its behalf I now declare the contest open for 1972 and may the best state win."

NEW SOUTH WALES

Canberra Radio Society

It was reported in the August issue of the Canberra Radio Society newsletter "The Repeater" that the support for the formation of a VK1 division of the WIA was growing. The proposal was set down for discussion at the society's annual general meeting on Friday 20th October, 1972.

The 144MHz beacon transmitter has been successfully tested, as has the keyer constructed by Eddie Penikis, VK1VP. The keyer consists of 4 IC's and a few diodes mounted on an 8" x 3" board and produces the beacon call sign in Morse code.

Society meetings are held on the third Friday of each month at 8.00pm in the Çivil Defence Rooms, Griffin Centre, Civic. Full details of the Society may be obtained by writing to the secretary, Box 1173, Canberra City.

Central Coast Amateur Radio Club

It is reported in the "News Sheet" of the Central Coast Amateur Radio Club that the channel 1 repeater has stimulated on the air activity in the area. This is reminiscent of the early days when club hook-ups were held on 3.5MHz.

At the July meeting a most interesting demonstration of glass blowing was given by Brian Chapman. During the evening many small ornaments were made.

Preliminary arrangements are being made for the 1973 Field Day, 18th February. Program details will be given in a future issue of these notes.

Funds are now available for further extensions to the club rooms and a building committee has been formed to handle the carpentry and electrical work.

Future events include participation in Gosford Show and the club Christmas party.

Full details of the activities of the club may be obtained from the Secretary, Dick Maitland, PO Box 238, Gosford 2251 NSW.

VICTORIA

Sunbury Television Group

The Sunbury Television group is a small group devoted exclusively to amateur TV and is anxious to correspond with groups or individuals participating in similar activities in other states.

The group has been operating for the past four years and have constructed in modular form their own solid state sync pulse generators, cameras, and camera control units.

Clubs or individuals are invited to contact the secretary, D. McDonald, 24 Higgins Avenue, Sunbury 3429. Victoria.

Geelong Amateur Radio & TV Group

The Geelong Amateur Radio Club station VK3ATL is now on the air using the recently acquired FT 200 transceiver. Club members are looking for local and DX contacts.

At a general meeting in August members discussed proposed improvements to the club rooms. These included installation of an additional window, replacing exterior weatherboards, maintenance to roof, and replacing a paling fence with chain wire mesh.

The channel 4 repeater has been undergoing modification and maintenance. During this period the unit has been located at the club rooms. Although the coverage is adequate for the Geelong and Bellarine peninsula, when the system has been proven it will be reinstalled at Gnarwarre, pending investigation of possible alternative sites.

Full details of the club may be obtained from the secretary, Bob Wookey, VK3IC, P.O. Box 520, Geelong 3220, Vic.

WIA YOUTH RADIO SCHEME

Ken Hargreaves, VK2ZIL, YRCS examiner reports that the following candidates were successful in Junior Radio Certificate examinations held between 21st June and 16th August 1972.

Parramatta Marist Brothers High School:
- Honours: Paul Curmi; Neil Warwick.
- Credit: Peter Molloy; Phillip Tesoriero.
- Pass: Paul Curmi.

St George Amateur Radio Club:
- Honours: Stephan Burnett; Barry Nivison-Smith.
- Credit: Richard Peir.

Westlakes Radio Club

A special presentation night for the YRCS awards won by Westlakes Radio Club members was held on Wednesday, 26th July, 1972.

The guest of honour was Mr Geoff Moore, a member of the Newcastle ABC announcing staff, who presented 28 certificates. Over 100 members and guests were present at the ceremony.

One member unable to collect his certificate was Garry Thorpe, who was on a Rotary Educational Scholarship in Japan.

Allan Cameron gained the distinction of being the youngest YRCS member to have gained the Intermediate Radio certificate. Allan is only 13 years old. Those receiving awards were:—

Elementary certificate:
- Pass: Stephan Bates; Mark Blackmore; John Bromell; George Richter; Bruce Steel.

Credit: Morgan Caldwell; Richard Hallinan; Peter Partridge; Ian Porteous.
Honours: Tim Baumfield.
Junior certificate:
Pass: Glendon Baguley; Kenneth Davies; Steven Kelly; Richard Payne; Jeff Smith.
Credit: Stephan Hallinan; Chris Marshall; Kevin Rugg.
Intermediate certificate:
Pass: Allan Cameron; Greg Shearer
Credit: Geoffrey Brown; Paul Lorger; David Griffiths; Garry Thorpe.
Honours: David Crofts; Eric Kiem.

The August issue of the Westlakes Radio Club "Newsletter" reported that the membership is now nearing 150, making it the largest YRCS club in Australia. The "Newsletter" contains many items of interest both technical and in a lighter vein, also advice on the correct methods of QSL'ing, maintenance of equipment and approach when answering examination questions.

Full details of the club may be obtained from the secretary, Eric Brockbank, Box 1 P.O., Teralba 2284 NSW.

Maitland Radio Club

The first "Honours" qualification on record for the YRCS Senior Radio Certificate was gained by Maitland Radio Club member John Gibson. Two other members, G. Watson and P. Lawrence, gained "Credit" passes at the same examination, the first to be held at the club.

Another New Zealander, L. T. Lewis, ZL2BCJ, has qualified for the "City of Maitland Award". The award is made available by the Maitland City Council through the Maitland Radio Club, to amateurs throughout the world.

To qualify, overseas amateurs must have a two-way radio contact with two members of the Maitland Radio Club. Australian stations are required to contact three member stations, plus the club's official station VK2-BHV or VK2ZVM.

More than 80 persons were in the MRC theatrette on Saturday evening 12th August 1972, when Mr N. V. Cornally, PMG's Department Engineer for the Newcastle Telecommunications Area, presented YRCS certificates to members. Mr Cornally praised the high standard of the passes obtained and congratulated the club on the work it is doing and the assistance it is giving young people interested in electronics.

Guests included, the Deputy Mayor of Maitland, Ald. N. Unicomb and Mrs Unicomb; Mrs Cornally; District Radio Inspector, Mr F. Hinks and Mrs Hinks; and Sgt. E. V. Cahill of Maitland Police and Mrs Cahill.

During the evening Sgt. Cahill presented prizes to Phillip Ellicott and Ian Lawrence who won the club's second broadcast listeners contest. Both have received special QSL verification cards from radio stations all around Australia.

ALBURY PROPOSAL
NSW Decision

A special general meeting of the NSW Division, WIA, was held at the WI Centre, Crows Nest, on 25 August at 8pm. The meeting was held to discuss the recommendations made at the Albury Conference of 8/9 July 1972.

The first part of the meeting took the form of a debate, with three members speaking for the proposed changes, and three against. Speaking for the changes were Allan Hennessy, VK2RX, Mike Farrell, VK2AM, and Roger Harrison, VK2ZTB. Speaking against the proposal were Ian McKenzie, VK2ZIM, Ian Binnie, VK2ZIU, and Chris Jones, VK2ZDD.

Following the debate the president called for comments from clubs, branches, affiliated societies etc. Comments were made on behalf of the Canberra Radio Society, the Hunter Branch, and the Central Coast Radio Club. The meeting was then thrown open for general discussion.

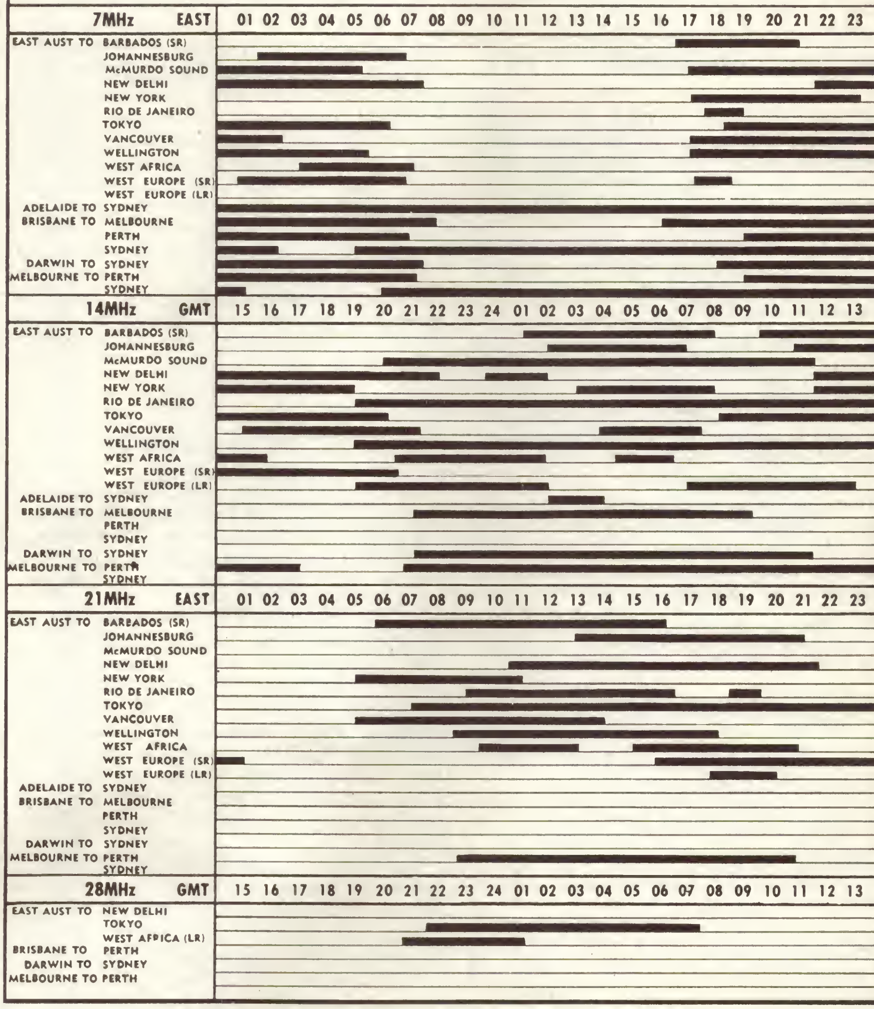
At the conclusion of the discussion, three motions were put. The first, moved by VK2ZDD, seconded VK2-ZGW, was: "That the federal councillor be directed to oppose any change to 2 metre net or repeater frequencies." After discussion the motion was carried by 113 to 16. (68 proxy, 61 present.)

A motion arising was moved by VK2APQ, seconded VK2ZDD. "That the federal executive be instructed, through the federal councillor, to take immediate steps through IARU and any other method available, to obtain international agreement on amateur satellite channel frequencies." This was carried 126 to 3.

A third motion, also arising out of the first, was moved by VK2ZIM, seconded VK2ZDD. "That the federal councillor be instructed to notify other federal councillors that in the event of a decision to change 2 metre net or repeater frequencies this (NSW) division will not follow suit until an international agreement is reached by or through the IARU." This was carried by 123 votes to 6.

IONOSPHERIC PREDICTIONS FOR OCTOBER

Reproduced below are radio propagation graphs based on information supplied by the Ionospheric Prediction Service Division of the Commonwealth Bureau of Meteorology. The graphs are based on the limits set by the MUF (Maximum Usable Frequency) and the ALF (Absorption Limiting Frequency). They have been prepared for the four most popular amateur bands over a number of interstate and international circuits. Black bands indicate periods when circuit is open. 10.72



A MORSE CODE STORY

Have you ever had the experience that was told in the Radio and Electronics Society of India magazine "R.A.D.I.O."?

"On a long overdue visit to the dental clinic I was ushered into the chair and the dentist began drilling. I am a radio operator, and much to my surprise I detected a pattern in his drilling. Paying closer attention I was astounded to read, perfect Morse code: Y-O-U S-H-O-U-L-D H-A-V-E S-E-E-N Y-O-U-R D-E-N-T-I-S-T L-O-N-G B-E-F-O-R-E.

"Seeing my expression, the dentist stopped drilling and explained sheepishly. 'You see, amateur radio is my hobby, and this work gives me an opportunity to practice my sending'."

Foundation For Amateur Radio

Should an overseas trip include a visit to Washington DC the following information from Charles Dorian, W3JPT, president, Foundation For Amateur Radio, will be of interest.

"The Foundation For Amateur Radio provides a central clearing house for information regarding amateur radio in the greater Washington DC area. Special consideration is given to visiting foreign amateurs, and a staff of linguists is available."

Information / Hospitality Committee chairman is Bill Parrott, W4URL, 8548 Georgetown Pike, McLean, Virginia 22101. Phone (703) 983 8383 between 8am and 8pm.

BOOKS & LITERATURE

Electronics In Japan

ELECTRONICS INDUSTRY OF JAPAN 1972, published by Noyes Data Corporation, Park Ridge, New Jersey. Soft covers, 210 x 275mm, 147pp. Price in USA $24.00.

This recent Noyes Data publication is aimed at giving a concise but detailed picture of the present state of the Japanese electronics industry.

It is divided into four sections. The first gives details of some 145 listed companies, including full name, address, date of establishment, capital, assets, principal executives, number of employees, major stockholders, bankers, technical agreements and products. The second section then gives more limited information about a further 714 unlisted companies. For these the details include full name and address, president, capital, number of employees and main products.

The third section then gives a statistical analysis of the present state of the industry, and its historical development. This section includes figures on production, trade, R & D, and employees. The final section gives an alphabetical list of registered trade names and the companies holding them.

A book which gives a vast amount of information about the important Japanese electronics industry, and therefore one which should be of very great value to anyone on the commercial side of the industry.

The review copy came directly from the publisher, whose full address is Noyes Building, Park Ridge, New Jersey 07656, USA. (J.R.).

Materials In Electronics

MATERIALS IN ELECTRONICS, by C. E. Jowett. Published by Business Books Ltd, London, 1971. Hard covers, 155 x 240mm, 321pp, diagrams and tables. Price in Australia $22.55.

An introduction to, and survey of the materials used in modern electronics — their manufacture, manipulation, characteristics and performance. It ranges from the materials used in integrated circuits and other semiconductor devices to the wires used for winding transformers, and deals with such diverse techniques as wire bonding, printed board etching, plating, vacuum sealing and environmental testing.

The book is well written, and although of necessity the author has had to adopt a rather terse and concise style, it is quite readable. It can therefore be recommended to engineering students, designers and quality control specialists.

The review copy came from Hicks, Smith and Sons Pty Ltd, who advise that copies should be available from all major bookstores. (J.R.)

Crystalline Defects

DEFECT ELECTRONICS IN SEMICONDUCTORS, by Herbert F. Matare. Published by John Wiley and Sons, Inc, New York, 1971. Hard bound, 160 x 235mm, 639pp, many illustrations. Price in Australia $26.20.

A rather specialised book, intended mainly for solid state research workers and for post-graduate students. As the title suggests, it was written to provide an up-to-date survey of the electronic aspects of defects in crystalline semiconductor materials, with particular emphasis on the dislocation.

Not having specialised knowledge of the book's subject I cannot make any valid criticism of either its contents or presentation. However the author has no less than two PhD's and some 50 patents in the field of solid state techniques behind him, so there is very good reason to believe that the book is all that it should be.

The book includes many microphotos of crystal defects, and a large appendix dealing with practical measurement of crystal properties. Each chapter concludes with a list of references and the book itself ends with symbol, author and subject indices. In short, then, a book which by all appearances should be of considerable interest and value to those engaged in semiconductor research.

The review copy came from the Australian office of the publisher. (J.R.)

Quantum Electronics

INTRODUCTION TO QUANTUM ELECTRONICS, by Paul Hlawiczka. Published by Academic Press, Inc, London, 1971. Hard bound, 158 x 235mm, 443pp, many diagrams. Price in UK .6.00.

Written as a text for undergraduates in electronics engineering and as a reference for practising engineers, this book has been planned and written to give a comprehensive treatment of all of the concepts in modern electronics derived from quantum mechanics. Not just with the overtly quantum operation of devices such as the maser and laser, but other important areas such as solid state physics, thermionic emission, optoelectronics, gas discharges, dielectric behaviour, ferro-and ferre-magnetism, and superconductivity.

It is divided into three sections. The first (10 chapters) gives an elementary introduction to semiconductors, electron emission, gas discharges and dielectrics. The second section (nine chapters) then gives the fundamentals of those concepts of quantum mechanics which are relevant to electronics. The third section (seven chapters) deals with paramagnetism, and includes microwave spectroscopy and the three-level maser. Devices dealt with in this section include ferrite microwave devices and superconductors. The books ends with a reading list, tutorial examples and subject index.

To this reviewer the book appears to be particularly well planned and executed. It is written in clear and concise language, and the emphasis is on imparting an engineering-orientated grasp of the concepts without excessive preoccupation with abstruse mathematics. I would therefore give it a very warm recommendation to all engineers and students seeking a sound yet highly readable introduction to these important concepts.

The review copy came direct from the publisher. (J.R.).

Radio Spectrum

RADIO SPECTRUM HANDBOOK by James H. Moore. Published 1971 by W. Foulsham & Co Ltd, England. Hard covers 9¼in x 6¼in (285mm x 158mm), 192pp. Price in Australia $10.20.

Not a cheap book by any means, but one that would provide plenty to interest the would-be DX (long-distance radio) enthusiast. The first three chapters deal

respectively with "Allocation of the Radio Spectrum," "The Nature of Radio Waves," and "Receiving Equipment."

Thereafter the book deals in turn with the major sub-divisions of the spectrum: low and very low frequencies, medium frequencies, high frequencies, very high frequencies and frequencies above VHF.

While the text is orientated basically to the situation in the USA, a foreword for British listeners points out that the broad principles of usage and administration are international rather than national. It would be equally useful to the Australian reader who wants a broad picture of what goes on around the world on the air waves. Our review copy came from Grenville Publishing Co Pty Ltd, 401a Pitt St, Sydney 2000. (W.N.W.)

LITERATURE In brief

STANDARDS ASSOCIATION OF AUSTRALIA, 80 Arthur Street, North Sydney, NSW 2060, has published the following new Australian standards, available from the various offices of the association at the prices noted.

AS 1188, SAA code for safety of electronic equipment. Lists rules for safe working practice to be adopted by personnel directly concerned with the operation and maintenance of electronic equipment. Besides electrical hazards, it also considers radiation, fire and radioactive hazards. Price $1.60 each.

AS 1171, Methods of magnetic particle flaw detection of ferromagnetic materials and components. It covers current flow, threading bar or coil, encircling and split coil, and magnetic flow techniques and their application; equipment characteristics; scanning using both longitudinal and shear wave probes; recording of flaw indications; estimation of flaw size; and presentation of data. Appendices deal with measurement of magnetic field and amount of magnetisation. Price $1.60.

The 1972 Annual List of Publications is now available from the SAA. It gives details of some 2000 Australian standards, and lists titles and prices of almost 2000 recommendations of the ISO and over 400 publications of the IEC. It includes a 29-page comprehensive subject index for Australian standards and a separate index for international publications.

FAIRCHILD BROCHURE. A brochure containing comprehensive data on the Fairchild range of power devices, as well as articles telling how to use silicon bimesar power, is available free of charge from Fairchild Australia Pty Ltd, 420 Mt Dandenong Rd, Croydon, Victoria 3136. The brochure has been prepared in Australia specifically for Australian users.

INFORMATION STORAGE AND RETRIEVAL. Varian ADCO, USA, has prepared an 8-page brochure describing the ADCO 926 large scale information storage and retrieval system, and this is available on request to Varian ADCO, 470 San Antonio Rd, Palo Alto, Calif. 94306, USA. System 926 permits retrieval of any microfilmed document from millions within an average of 14 seconds and a maximum of 18 seconds. The brochure describes the system's encoder, mounter, remote viewing, rapid remote access, and various options.

LISTENING AROUND THE WORLD

by Arthur Cushen MBE

New Transmitters for Radio Canada

Radio Canada International is now using 250kW transmitters at Sackville for its service to the South Pacific, as well as to most other areas in the world.

The Canadian Broadcasting Corporation is rapidly expanding its services as further 250kW transmitters are put into service. The present schedule, given below, includes some new frequencies. Transmissions carried on the old 50kW transmitters are indicated with (x).

kHz	GMT
5960	0045-0715 (x)
5970	0815-0945, 1215-1315.
5980	0545-0630, 0700-0815.
6085	0045-0415.
6090	0400-0630 (x).
9605	0145-0415.
9625	0000-0945, 1045-1215, 1515-1530, 1630-1700, 2145-2400.
9635	0045-0200.
11720	0045-0715, 1045-1345, 2145-2300 (x).
11845	2000-2230.
11945	0000-0200, 2245-2400 (x).
15190	0000-0100, 2245-2400 (x).
15315	1215-1345 (x).
15320	1830-2000 (x).
15325	1045-1830, 2000-2230.
17820	1045-2200 (x).
21595	1345-2000 (x).

NEW DX PROGRAM

A new DX program has been introduced by the Voice of Hope, broadcasting over the transmitters of Trans Europe in Portugal on 9670kHz, Sundays at 0545 GMT. The schedule operating from November 1 will include a new half-hour program in English devoted entirely to Adventist World Radio listener requests. "AWR-This Week," as it will be called, will present religious music requests from listeners.

DXers are urged to send their DX news directly to AWR, Box 5409, Paris 9e, France. Suggestions and letters from around the world will be used and acknowledged over the air. Broadcast time for the new show is tentatively set for 0545GMT on Sunday on 9670kHz.

In an effort to provide programs when reception is best in primary target areas, AWR will make a major program schedule revision beginning November 1.

FREETOWN ON 3316kHz

Broadcasts from Sierra Leone are among the most difficult to hear in New Zealand. Transmissions from this country have been heard by Dene Lynneberg, of Wellington. Radio Sierra Leone, at Freetown, operating on 3316kHz, was noted from 1905GMT till after 1950GMT. The program was in English and vernaculars and had a high commercial content, with the time given frequently. Freetown time is the same as GMT.

The music was mainly of a popular nature, with local numbers. The signals suffered a strong heterodyne interference on the upper sideband and from telegraph on the lower sideband. The address of the station is Radio Sierra Leone, New England, Freetown, Sierra Leone.

AFRICAN SIGNALS

NIGERIA: The Nigerian Broadcasting Corporation at Calabar has been heard by Dene Lynneberg, Wellington, NZ, on 6144kHz at 0500GMT, with popular music and announcements in English. At 0645GMT the familiar drumbeat interval signal was heard, followed by news in English. Signals were fairly good and readable in New Zealand, although Cologne transmits on 6145kHz.

CAMEROONS: Dene Lynneberg advises that Radio Buea, on 3970kHz, is giving good reception with English news at 1830GMT.

SOUTH AFRICA: John Mainland, Wellington, NZ, reports that Radio South Africa has been heard with its internal service for Indian Listeners on 11790kHz on Sundays at 0635GMT.

LIBERIA: ELWA, at Monrovia, has been heard at good level by Bryan Clark, Wellington, NZ, with religious music at 1915GMT.

WINB ON 15185kHz

The Gospel broadcaster WINB at Red Lion, Pa, USA, has been observed on the new frequency of 15185kHz. Signals in New Zealand are at fair level from around 2200GMT till signoff at 2245GMT. The station broadcasts mainly gospel programs and requests reception reports to PO Box 88, Red Lion, Pa, 17356, USA. The present schedule is:

GMT	KHz
1700-2000	17720
2002-2245	15185

TESTS FROM ISRAEL

The Israel Broadcasting Authority, Jerusalem, has been conducting test transmissions for listeners in Europe. Reception has been excellent on their normal frequency of 9009kHz, and at times on 9625kHz, when they have an English news bulletin at 2045GMT and continue in French at 2115GMT.

Recently tests have been carried out on 6170 and 7225kHz, as well as other frequencies in these bands. We have heard them using the 25m band for these tests. They have English news at 2045GMT on 11760kHz, and the full schedule on this frequency is 2045-2250GMT. Another channel, 11790kHz, is used 1500-2030GMT. The station is asking for reception reports to the Overseas Section, Israel Broadcasting Authority, Jerusalem.

YVSB ON 6010kHz

We have recently heard a Venezuelan signal on 6010kHz from around 1025GMT, using the slogan Radio Los Andes. Bob Padula of Melbourne, Vic, also reports reception of this station, which seems to have been inactive for some months. The sign-on is around 1025GMT, and the slogan is often given, as well as the location, which is Merida. At 1048GMT the Voice of America transmitter at Okinawa comes on the frequency and further reception of YVSB is spoilt.

JAPAN'S NEW FREQUENCIES

Radio Japan at Tokyo has introduced three new frequencies for its regional services for the present spring period. These are 21640 to North America, 9735 to Europe and 11780 to Latin America. The full schedule is:

GMT	kHz
0100-0300	21640, 17825, 17725, 15235
1930-2100	9735, 11960
0900-1100	11780, 9605, 9530

RECENT VERIFICATIONS

COLOMBIA: Radio HJNV, Radio Vision, at Medellin, confirmed our reception in 14 days with a postcard illustrated with a native flower. The station, which is a member of the Caracol Network, is on 6105kHz, and has been heard at 1030GMT, also at 1052 with a devotional program. The address is Apartado Aereo 718, Medellin, Colombia.

BOLIVIA: Our verification from CP73 on 4795kHz was in the form of an airmail letter which gave details of the verification as well as information about Bolivia and its population. Included in the letter were tickets to a local folklore show staged by Radio Nueva America. The verification was signed by Raul Salmon, General Director, Radio Nueva America, Casilla 2431, La Paz, Bolivia.

PERU: A verification letter to Chris Davis, Featherston, NZ, from Radio Voz de Chira, states that they are now called Radio Sullana.

BRAZIL: A letter received by Chris Davis from Radio Clube do Para says they have increased power from 2kW to 5kW. The frequency is 4865kHz, and the callsign is PRC5. The address is Caixa Postal 533, Belem, Brazil.

BANGLADESH SCHEDULE

The schedule of the Home Service of Radio Bangladesh at Dacca is as follows:

GMT	kHz
0030-0400	4915
0030-0430 (Sun)	4915
0030-0220	9690, 15520
0600-0900	9740, 11620, 17935
0600-0930 (Sun)	9740, 11620, 17935
1100-1245	9740, 11620
1100-1220	17935
1100-1220	4915
1300-1705	4915
1405-1545	9690
1635-1705	9690
1405-1545	11650
1635-1705	11650

AUSTRIAN SCHEDULE

The latest schedule of Austrian Radio, Vienna, shows a frequency change for the service to Australia and New Zealand, with 21585kHz replacing 17785kHz. The present frequencies are as follows (old frequencies in brackets):

GMT	kHz	GMT	kHz
1200-1400	11930 (11785)	1600-1800	17850 (17835)
0000-0200	15250 (15145)	0400-0600	17740 (17785)
2300-2400	9535 (9680)	1000-1200	21585 (17785)

RADIO NEW ZEALAND SCHEDULE

The present schedule of Radio New Zealand in Wellington includes a change of time for the transmission to the Antarctic from 0015-0045GMT on Sunday to 0815-0845GMT the same day. The full schedule is as follows:

	GMT	kHz
TO THE PACIFIC	1700-1945	6080, 9755
	2000-0545	15110
	0600-0845	6080, 9540
TO AUSTRALIA	2000-0545	17770
	0900-1145	9520, 11705
TO ANTARCTIC	0815-0845	15280 (Sunday only)

Programs in the Samoan language are Tuesdays 0730-0800GMT, in Rarotongan language Wednesdays 0820GMT; and in Niuean language on alternate Wednesdays at 0730GMT.

Radio New Zealand welcomes reports to PO Box 2396, Wellington. Listeners' reports should include the wave-length or frequency of transmission, date, time, some program detail and comments on interference.

FLASHES FROM EVERYWHERE

BELGIUM: Station ORU in Brussels has been heard on the new frequency of 15285kHz in its service to North America, from 2300 to 0100GMT. The 10-minute English program "Belgium Speaking," broadcast daily at 2305 and 0500GMT, has news and commentary and a mail bag session.

MALAWI: A new station in Malawi is Lakeland Radio in Blantyre, which operates 1900-2100GMT on 5995kHz with a power of 100kW. The programs are in English. The station is leasing a transmitter from the Malawi Broadcasting Corporation. The address is Lakeland Radio, PO Box 30211, Chichiri, Blantyre, Malawi.

SWAZILAND: Swazi Radio is now on the air 0400-1500GMT on 6155kHz and 1500-2200GMT on 3223kHz.

ETHIOPIA: "Sweden Calling DXers" says that Radio Ethiopia has been observed in English at 1600GMT on 9580kHz.

CAMEROONS: Radio Buea is giving good reception at 1830GMT on 3970kHz, says Dene Lynneberg, of Wellington, NZ. At this time, the station was heard with a news bulletin in English.

MONGOLIA: DX Club of India, advises that Ulan Bator has English 1220-1250GMT (except Sunday) on 17780 and 17820kHz. A second transmission is 2200-2230GMT (except Monday) on 11810 and 11860kHz.

KHMER REP (CAMBODIA): Broadcasts from Phnom-Penn have been heard by Chris Davis, Featherston, NZ on the frequency of 6090kHz, announcing as Radio Khmer. Reception was at 1245GMT when English and French were heard. The signal suffered interference from VL16 in Sydney, NSW.

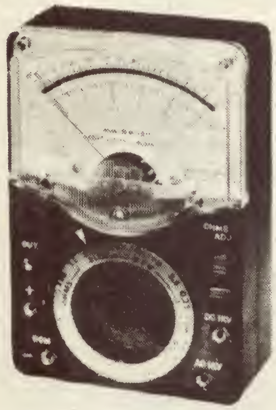
The station has also been heard on 4907kHz at the same time.

UZBEKISTAN: Radio Tashkent continues to be heard on new frequencies with its English programs at 1200 and 1400GMT. The latest frequency to be heard is 15420kHz. At this time the same program has also been received on 11730, 11925 and 15115kHz.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, New Zealand. All times are GMT. Add 8 hours for WAST, 10 hours for EAST, and 12 hours for NZ.

NEW RH (Radio House) RANGE OF MULTIMETERS

MODEL RH-60 $29.00 Packing & Postage $1.00



50,000 Ohms per Volt DC.
10,000 Ohms per Volt AC.
Specifications:
DC Volts: 0.25, 2.5, 10, 50, 250, 500, 1000.
AC Volts: 10, 50, 250, 500, 1000.
DC Current: 25uA, 5mA, 50mA, 500mA.
Resistance: 10K, 100K, 1M, 10M.
Decibels: —10 +62dB.
Accuracy: DC ±3 p.c., AC ±4 p.c. (of full scale).
Batteries: Two 1.5V dry cells. Overload protected.

MODEL RH-100 $39.75. Postage $1.00

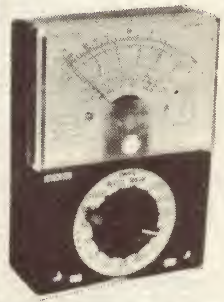
100,000 Ohms per Volt DC 10,000 Ohms per Volt AC

• Overload protected by dual silicon diodes • Double-jewelled ± 2 per cent meter • ± 1 per cent temperature-stabilised film resistors • Polarity changeover switch • Mirror scale • Instructions for operation with circuit diagram.

SPECIFICATIONS:
DC Volts: 0.6, 3, 12, 60, 300, 600, 1200 (100,000 / V).
AC Volts: 6, 30, 120, 300, 1200 (10,000 / V).
DC Current: 12A, 300A, 6mA, 60mA, 600mA, 12 amps. AC Current 12 amps.
Resistance: 20K, 200K, 2M, 20M.
Decibels: —20 to +17, 31, 43, 51, 63.
Accuracy: DC ±3 per cent. AC ± 4 per cent (of full scale).
Batteries: Two 1.5V dry cells, size AA, "Eveready" 915.

"HANDYMAN" RH150 $11.50

CHECKED PACKED & POSTED $12.00



Pocket-size 3¼" x 4½" x 1¼".
Instruction sheet and circuit.

SPECIFICATIONS:
DC Volts: 2.5, 10, 50, 250, 1000. 10,000 ohms per volt
AC Volts: 10, 50, 250, 500, 1000.
DC Current: .1, 25, 250mA.
Resistance: 20K and 2M.
Decibels: —20db, +62dB, 0.7KHz.
Capacitance: .0001, .01, .0025, .25uF

MODEL RH-20 $15.00 Packing & Postage 75c

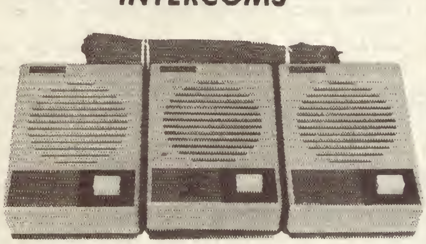
20,000 Ohms per Volt DC.
10,000 Ohms per Volt AC.
Specifications:
DC Volts: 0.25, 2.5, 10, 50, 250, 1000.
AC Volts: 10, 50, 250, 500, 1000.
DC Current, 50uA, 25mA, 250mA.
Resistance: 7K, 700K, 7M.
Decibels: —10, +22 (at AC / 10V) + 20, +36 (at AC / 50V). Upper frequency limit 7KHZ
Batteries: Two 1.5V dry cells.
With overload protection $18.00.

MODEL RH-80 $20.00 Packing & Postage 75c

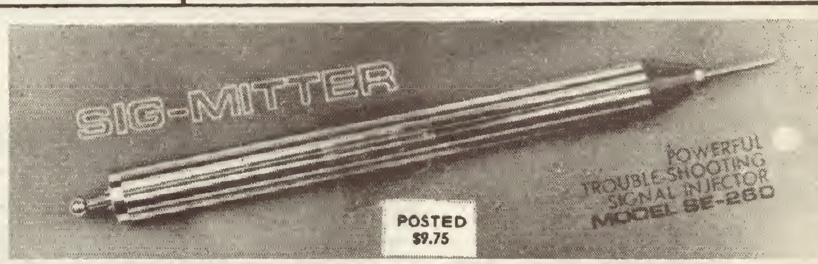
20,000 Ohms per volt DC.
10,000 Ohms per volt AC.
Specifications:
DC Volts: 0.5, 2.5, 10, 50, 250, 500, 1000.
AC Volts: 10, 50, 250, 500, 1000.
DC Current: 50uA, 5mA, 50mA, 500mA.
Resistance: 5K, 50K, 500K, 5M.
Decibels: —10dB + 62dB.
Accuracy: DC 3pc. AC 4 per cent (of full scale).
Batteries: Two 1.5V dry cells, size AA, "Eveready" 915.

• Overload protected by dual silicon diodes • Double-jewelled ± 2 per cent meter • ±1 per cent temperature-stabilised film resistors • Mirror scale.

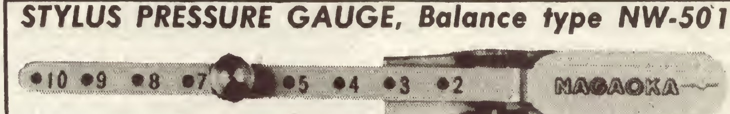
INTERCOMS



"Gem" 3-station $19.75
"Homer" 2-station $12.75
"Edison satellite" 2-station $9.75
Postage 75c



STYLUS PRESSURE GAUGE, Balance type NW-501



$1.50 Posted

RADIO HOUSE PTY. LTD.

306-308 PITT STREET 61-3832 26-2817 760 GEORGE STREET SYDNEY. 211-0171

ANSWERS TO CORRESPONDENTS

AMPLIFIER SPECS: In the "Versatile Public Address Amplifier" published in the December, 1970 issue of EA, a pair of AD149 germanium transistors are used in the output stage. When delivering full power, these transistors swing 45 volts, yet the maximum collector-emitter voltage is 30 volts. In setting the protection circuit in the power supply, a 7.5-ohm resistor is used, representing a current of 6 amps, but 30 watts into 8ohms is approximately 2 amps. Why was such a high level chosen? In many amplifiers, the maximum load current quoted seems far less than that drawn by the load at full power. For example, the Playmaster 128 delivers 64 watts into 4 ohms, and since $W = I^2 R$, this represents a current drain of 4 amps, yet the quoted current drain of the amplifier is 2 amps. Why is this so? The Playmaster 132 is claimed to have a damping factor of 56 into an 8 ohm load, while that of a similar Philips design claims 160 — why the discrepancy? By the way, the drill speed controller, Playmaster 131 Tuner and Playmaster 125 Guitar amplifier work beautifully! (M.S., Rose Bay, NSW).

First off, M.S., thanks for the comments on the latter projects that work satisfactorily. With that said, let us proceed with your questions. When considering the power output of the amplifier and the load on the power supply, these points should be kept in mind: A 2 amp RMS current in the load corresponds to a peak current of 2.8 amps and this corresponds to a 6 amp peak current drawn from the power supply, when one considers the positive and negative half-cycles of the waveform. The output coupling capacitor supplies a 2.8 amp negative peak current, while the positive peak current is effectively made up of the 2.8 amp peak into the speaker, plus that required to replace the change supplied during the negative half-cycle by the capacitor (another 2.8 amp peak); the total is approx 6 amps. This last current is that which is sensed by the power supply cutout circuit.

Your question about the ratings of the AD149 are partially true, the qualification here being the difference between the BVces and BVceo ratings. Above about 180 ohms Rbe, the AD149's breakdown rating does drop to 30 volts. But in the PA amplifier, the base resistance is less than 180 ohms, and for these conditions the AD149 rating rises to 50 volts.

Concerning the Playmaster 128 amplifier, an 8 ohm load was used as the design criteria, although the unit will handle the extra peak current demands of a 4 ohm load. However it should be noted that the power levels and performance figures were quoted for ONE channel, and under these conditions, the power supply current will be under 2 amps (RMS). For two channels, the power supply is adequate for the demands of the so-called "music power" rating, although not for two channels delivering full sinewave power.

"Damping factor" of the Playmaster 132 (of the order of 65) was that measured into a resistive load using the prototype. In practice, damping factor takes on an arbitrary significance because loudspeaker impedance changes significantly with frequency. The actual electrical damping depends on the resistance of the speaker coil, and because of this increasing the damping factor above about 20 has negligible effect.

TIME SWITCH: I would like to build a device which can be connected to any electrical appliance (such as a TV set) to turn it off at a set time. I understand that you published the circuit for such a device in the "Reader Built It" section of your magazine. Could you please refer me to the relevant issue. (R.A., Pascoe Vale, Vic.)

We published a time switch made from an alarm clock in the RBI section in September, 1969, on page 109. We can supply a reprint of this page through the Information Service for 30c.

MODEL TRAIN LIGHTING: I was interested to read your articles on lighting for model trains in your issues of October to December, 1967. However, I thought there would be an easier way to achieve this without using rechargeable batteries. My idea is to use a three-rail track, using one rail as common, the other as control for the train and the centre rail for lighting. A collector "shoe" underneath the train would pick up the power for the lighting from a separate power supply. If the operator already has a two-rail system, it would be expensive to replace all the tracks, but I have seen a corrugated copper strip about ⅛in wide, used for fixing to certain types of two-rail track to convert it to a three-rail system. This is fixed with adhesive between the running rails. I commend you on your extremely good magazine, and especially for the "elementary electronics" section. Have you ever published a design for a portable RC bridge and a signal injector? (K.R., Mona Vale, NSW.)

In our experience, most model railway enthusiasts will not consider three rail systems nowadays, since they lack realism. However, we publish your comments in case anybody is interested. Thank you for the suggestions, and also for your comments about the magazine. We have published a number of circuits for both RC bridges and signal injectors. In the April, 1968 issue, we published a design for a combined signal injector and RC bridge, which may be best for your purpose. A project reprint for this can be obtained from the Information Service for 50c (File No 7/B/9).

RADIO CONTROL: I would like to know if you have ever described a 2 or 3 channel proportional control transmitter and receiver for radio control of model aircraft. I read your article on the garage door opener, but it does not suit my requirements. Also, my parents do not like the idea of my outside antenna, as they say it may be struck by lightning. Can you suggest some way to prevent this? (G.N., NSW.)

We have never described such a transmitter/receiver, but we will keep the idea in mind for a possible project should time and space permit in the future. There is probably no way in which lightning can be prevented from striking anything — including human beings — if the lightning is that way inclined at the time. The best that can be done is to minimise the effect of the strike when it happens. Lightning arrestors on buildings work on this principle. Assuming an aerial has a path to earth it will function in much the same way, although the receiver in the path may suffer damage in the process. The most common protective device is a small spark gap, connected between aerial and earth terminals of a set. This will break down when the voltage across reaches a pre-determined value. These devices are available commercially. In all honesty, however, we must point out that risk appears to be almost negligible, considering the number of aerials in use and the rarity of a strike.

CDI: After having read your magazine for some years now, I feel a lot of projects are interesting and of good value, but I think you go overboard with some of them, tending towards complexity. Surely good results, if not the same, could be obtained from simpler designs. With a CDI system, where can a tacho be connected? I have placed mine across the breaker points instead of its original position across the coil. It seems to work, but is erratic at high speeds. Does the dwell angle setting have to be as critical as before? I have found that an increase in the plug gap by .015 to .040in gave remarkable improvements in fuel consumption, idling and cold starting, and that fitting suppressors to each plug improved the cold starting capability. The increased plug gap increased the breakdown risk bet-

"ELECTRONICS AUSTRALIA" INFORMATION SERVICES

As a service to readers "Electronics Australia" is able to offer: (1) Project reprints, metal work dyelines, photographs, printed wiring patterns and other filed material to do with constructional projects and (2) A strictly limited degree of assistance by mail or through the columns of the magazine. Details are set out below:

PROJECT REPRINTS: These cost 50c per project. Reprints are available for all projects, but no material can be supplied additional to that already published. Reprints can be supplied more speedily if they are positively identified and not accompanied by technical queries. Material not on file can normally be supplied in photostat form at 30c per page.

SUBSCRIPTIONS, BINDERS, HANDBOOKS etc: These are handled by separate departments. For fastest service, send separate orders to the departments concerned.

PHOTOGRAPHS, METAL WORK DRAWINGS: Original photographs are available for most projects. Price: $1 for 6in x 8in glossy print. Metal work dyelines are available for most projects. Price: $1 These show dimensions and positions of holes and cut-outs, but give no wiring details.

PRINTED WIRING PATTERNS: We can supply transparencies, actual size, positive or negative, as specified Price: 50c. We do NOT deal in manufactured boards. These are available from advertisers.

BACK NUMBERS: As available. On issues up to six months, face value. Seven months to 12 months, face value plus 5c. Thirteen months or older, face value plus 10c. Postage and packing, 10c per issue extra. Please indicate if a PROJECT REPRINT may be substituted if the complete issue is not available.

REPLIES BY POST: These are provided to assist readers encountering problems in the construction of our projects published within the last two years. Note, particularly, that we cannot provide lengthy answers, or undertake special research or modifications to basic designs. Charge: 50c. Inclusion of an additional fee does not entitle correspondents to special consideration.

OTHER QUERIES: Technical queries outside the scope of "Replies by Post" may be submitted without fee and may be answered in the magazine at the discretion of the Editor. Technical queries will not be answered by interview or telephone.

COMMERCIAL EQUIPMENT: "Electronics Australia" does not maintain a directory of commercial equipment, or circuit files of commercial or ex-disposals equipment etc. We are therefore not in a position to comment on any aspect of such equipment.

COMPONENTS: "Electronics Australia" does not deal in electronic components. Prices, specifications, etc should be sought from appropriate advertisers or agents.

REMITTANCES: These must be negotiable in Australia, and should be made payable to "Electronics Australia". Where the exact charge may be in doubt, we recommend submitting an open cheque, endorsed with a suitable limitation.

POSTAGE & PACKING: All charges shown include postage and packing, unless otherwise specified.

ADDRESS: All requests for data and information should be directed to the Assistant Editor, "Electronics Australia", Box 2728, GPO Sydney, NSW, 2001.

(10/72)

Approval is not a licence

ILLEGAL TRANSMITTERS: I recently purchased a pair of 1 watt walkie talkies. These have, to date, given excellent service. However, the purchase of these has raised several questions: The advertisement (in EA) which caused me to buy them states they are PMG approved. Does this mean that no licence is necessary? With only one watt output, it is difficult to make myself heard. Have you ever described an RF amp for the 27MHz band? As yet, I have only had one contact (a company mobile). How do I obtain other contacts? This contact told me I am heterodyning. Could this be a manufacturer's fault? (P.H. Wollstonecraft, NSW.)

Your next letter could well come to us from the court, PH. We can only reiterate what we have said many, many times before. No transmission of any type may be undertaken without the appropriate licence from the PMG's department. There are very heavy fines, even jail sentences for those who break this law. Type approval is NOT a licence. It is merely an acknowledgement that the PMG's dept is satisfied that the technical standards it lays down have been met by that piece of equipment. The fact that the contact you had was a company should have given you some indication that this band is not meant for use by anyone and everyone. People who are issued with licences to operate in the 27MHz band must have valid reasons to do so. If you take our advice, you will cease transmitting forthwith, otherwise it is only a matter of time before you will be caught and prosecuted. Incidentally, confiscation of the equipment is automatic, on top of whatever other penalty the court imposes.

ween the plugs and the engine block, and I had to fit rubber covers to prevent this. A good article. Could you describe an exhaust gas analyser for tuning carburettors? (C.M., Oaklands Park, SA).

Thank you for your comments about the projects, C.M. Unfortunately, some may appear to be over-complex — but if there were a way to reduce this we certainly would, as we have no wish that our readers spend more money than they need to on components. If some designs were simplified, they would not perform as well as could be expected, and the reproducibility of some would be poor. The majority of impulse-type tachometers will NOT work satisfactorily with CDI systems. This is mainly due to the lack of broad pulses for proper "summing" and shaping, plus the fact that higher current levels are available for longer periods with the Kettering system. Dwell angle, in a CDI system is that time required to switch off the thyristor after a discharge, and to recharge the "dump" capacitor for another cycle. This period is usually a tenth (or shorter) the time of a Kettering dwell (or energy storage) time; thus, mechanical dwell time hardly comes into the picture. For minimal timing errors, it is advisable to set the breaker point gap to the same order as that recommended by the manufacturer of the vehicle. It is good to know that you have had good performance with the CDI. At the moment, we have no plans to describe an exhaust gas analyser.

POWER MATE: I wish to use the power supply described in the June 1972 issue of the magazine, but want to obtain a lower voltage than 3.5V. I require 1.5V. Is it possible to use a lower input voltage to do this (say by using the 12.6VAC tap on the transformer) (G.H., Tuart Hill, WA).

3.5V is the minimum output voltage available with this circuit. Changing the input voltage will not change it. In fact it is not possible, with this IC, to obtain a lower output voltage than 2.5V, and even to get this low necessitates a switch to change the circuit configuration. Sorry!

MOTOR CYCLE CDI: I would like to congratulate you on an excellent magazine. However, I do not agree with your comments and answers to correspondence May, 1972 (CDI for motor cycles). I do realise, from my own experience as service manager for a Queensland distribution company, the problems which are experienced with 2 stroke ignition. The average life of a spark plug is 500 to 1,000 miles and considerable benefits can be noted by some Japanese motor cycles which are fitted from the factory with CDI ignition. I have fitted a single cylinder 2 stroke motor cycle of Japanese origin with CDI ignition and, at present, the spark plug shows no sign of wear after 4,000 miles, which is considered exceptional in a 2 stroke motor cycle. I, for one, would appreciate it if you could publish a design which would suit the multi-cylinder 2 stroke motors, as most of these units are fitted with separate points and ignition coils for each cylinder. (J.K., Bulimba, Qld.)

Thank you for your comments, J.K. Unfortunately, as you did not indicate which points in our previous reply you do not agree with, we are unable to comment further. Unfortunately, we have nothing in preparation at the moment for a project on CDI for multi-cylinder two-stroke motors. This would be a difficult project, involving many hours of design and development work, and our staff is too heavily committed at the moment to undertake such a project.

CIRCUIT MODIFICATIONS: I have been interested in electronics only a short time, and have a number of questions. I am considering building the All-wave Two receiver; is it possible to use the integrated circuit RF amplifier described in the April, 1972, issue instead of the original FET RF amplifier, but still using the All-wave Two tuner arrangement? Can you tell me the frequencies used by police, fire brigades, ambulances and radio telephones generally? I understand a wire strung between two posts for an aerial has directional properties, and the maximum pickup is achieved when the wire is either pointing toward the radio station or is at right angles to it. Which is correct? (I.S., Narrabri, NSW.)

We would strongly advise you to stick strictly to the design of the All-wave Two receiver as published, particularly in view of your limited experience. We cannot offer any advice or assistance with modifications to our published designs, and we are not in a position to provide information about radio telephone frequencies. We would point out that there

are very strict regulations relating to reception of messages transmitted by radio telephone. In general, for a simple "inverted-L" aerial, reception is likely to be best for signals arriving broadside on to the aerial wire.

TACHO: I would like to suggest a project on a digital tachometer for use in a car. This could use a two digit readout, and count in hundreds of RPM. This would be far more accurate than a conventional tacho. I feel it would be a relatively easy circuit using logic ICs and would not run into much more expense than a conventional tacho. (R.W., Qld.)

While the idea has some merit, we cannot agree with your comments on the cost of such a project, R.W. Some mechanical tachometer kits cost less than ten dollars — the price of a one-digit readout would probably approach this figure. Nevertheless, we will keep the idea in mind.

DELTAHET: I am considering constructing the Solid State Deltahet receiver as described in the February to May, 1971 issues of "Electronics Australia" and I would like to correspond with any readers who have built this receiver. I would be interested in any difficulties encountered and how this receiver shapes up with regard to performance and any comparisons with commercial receivers. (Kevin J. Crockett, Box 36, Manangatang, Victoria 3546.)

The Deltahet receiver is a rather costly project, and we feel that the request is a reasonable one. It is now up to any readers who wish to contact Mr Crockett on this subject.

CAN ANYBODY HELP? Thank you for such an interesting magazine. Can anybody help me with advice on how to operate a Taylor Model 45-A Valve Tester. I have such an instrument but I do not know how to operate it. At present, I can test only valve filaments. The set works from 110V, 210V or 240V mains supply. If anybody knows how to operate it, would they please write to me direct. (Michael Hampshire, Lavers Hill, Victoria 3238.)

At your request, we are publishing your name and address, and hope that some or our readers may be in a position to assist.

MUSICOLOUR TWO: I am interested in building the Musicolour two, but I don't know where to get the proper printed circuit board. Could "Veroboard" be substituted? If this is inadvisable, could you tell me where I may obtain the proper board. (G.McG., Inala, Qld.)

While it is possible to use Veroboard, we do not advise it, considering the dangers of direct mains operated circuitry. We strongly suggest you obtain the correct printed board. In Queensland, these are available from Walton Trent Electronic Developments, 8 Stark St, Dorrington. Alternatively, all boards are available from RCS Radio, 651 Forest Rd, Bexley, NSW, 2207.

CRO SWITCH: In the Dec 1962 issue, details of an electronic switch were published. The unit allowed a single beam oscilloscope to display two patterns much in the same way a dual beam instrument does. I feel it is time a revised version of the switcher appeared in your magazine. I envisage a solid state version with a few embellishments to extend its usefulness. (R.K., Canberra, ACT.)

Thank you for your comments and suggestions R.K., and we will certainly keep this idea in mind as a possible future project. Unfortunately, time is the enemy and we will have to place such an idea well down the list. Also, we wonder how many other readers would like such a project. Perhaps they would care to let us know.

ADVICE WANTED: I am considering building the Playmaster 132 Amplifier. I have never tackled anything as complicated as this before and I should be interested to hear from other constructors about the reproducibility of the apparently excellent specifications, ease of construction and performance of the tuner. Will you therefore publish my name and address. Could a headphone socket be attached to the amplifier? If so, how? (Peter Hill, 28 Golden Grove, Red Hill, ACT 2603).

As requested, we have published your name and address, and hope you will be contacted by interested readers. We cannot discuss modifications to our designs for individual readers, but we draw your attention to the stereo headphone adaptor described in the December, 1969 issue. A project reprint of this can be supplied through the Information Service for 50c (File No 1/MS/7).

WORK: I am sixteen years old, and have been buying your magazine for four years. In this time I have learnt all I know about electronics. I recently constructed the low cost stereo amplifier, with complete success. Now, I feel I should know more about electronic test equipment. So, if possible, could you print my full name and address, so that anyone who is interested in helping me might be able to get in touch with me. I may be able to work afternoons and weekends assisting in a workshop, which would increase my practical and theoretical knowledge. (Gerard Slade, 24 Booraba Ave, West Lindfield, 2070).

While this request is a little out of the ordinary, we will print your name and address as requested. Anyone who cares to may get in touch with Gerard directly.

PRODUCTS: Sinclair Project 605 Kit

(Continued from page 105)

At this juncture the system was operational but with two residual problems: hum with volume and bass controls more than half-on, and a tendency to low frequency motorboating. To cure the latter, we had to replace the 200uF decoupling electrolytic on the control module with 1000uF.

Disconnecting the mains wiring from the off/on push-button reduced the hum problem. For good measure, we shortened all the leads and replaced the open pickup wiring from the distribution board to the control board with shielded twin lead.

This done, the hum level was just above audibility with the controls set for normal playing level with a low output magnetic cartridge. With the gain control at zero, the amplifier was dead quiet, indicating clearly that the problem was one of transformer radiation into the exposed and vulnerable input circuitry.

To cure this we had to dismantle the power supply and add a 30g copper strap around the outside of the core, following the contours of the winding.

All this, of course, is completely foreign to the original concept but the conclusion is clear enough: mounted under a plinth and used under non-demanding conditions the 605 kit might be regarded as potentially satisfactory. But as the basis for "a superb 30-watt high fidelity stereo amplifier" (a quote from overseas advertisements) it would really need expert assistance.

What of the power output?

Under no-signal conditions, the supply voltage available from the non-stabilised PZ.5 power supply approximates 28V, which is substantially lower than the 35V specified if the Z.30 power module is to deliver 15W RMS. The actual power available from our particular Project 605 kit at 1kHz steady tone turned out to be 8W RMS per channel into 8 ohms at the point of clipping.

Input sensitivity to the pickup channel is 3mV at a nominal impedance of 50,000 ohms. This is ample for any likely magnetic cartridge and the built-in compensation conforms to RIAA requirements.

The "auxiliary" channel has the same nominal sensitivity at 1000Hz, but preset

SOUND PROJECTORS
Cinevox Prefect and Harmour and Heath 16mm in good working order. 240v operated, complete with speaker and amplifier.

from $115.00

CIRCULAR SLIDE RULE
3¼in diameter. Will do the same work as the conventional slide rule. Instruction book included.

from $1.60 each
Post 12c.

P.M.G. TYPE TELEPHONES
Standard desk type with magneto bell calling device. Range 30 miles. Uses standard batteries at each phone. Any number can be connected together on single line.

$25.00
(2 TELEPHONE SETS)
30c. cartage to rail. Freight payable at nearest attended railway station. Please note we are now able to include ¼ mile of twin telephone cable FREE with each set of phones.

PYREX PARABOLIC REFLECTORS
36" diameter $37.50
Sorry, shop sales only.

MINIATURE ELECTRIC MOTORS
1½ to 3 volts DC. Ideal for model boats, cars, planes, etc. Strong torque. Only

65c. each or 10 for $4
(Post 12c.)

TRANSCEIVER
(2-way radio) R.C.A. America RT 68, 24 volt, operated 10 watt output 38-54MHz F.M. crystal locked. Transmitter and receiver using frequency synthesiser in 100KHz; step 10 channel per MHz with power supply, mike, and headphones. $45. 60c. cartage to rail. Freight payable at nearest attended railway station.

TRANSCEIVER
(2-way radio) 62 set, 12V, operation. Ideal Hams, etc. 1.6 to 10MHz. Crystal locked or VFO controlled. 5 watt output. Complete with antenna, headphones and mike. $60. 30c. cartage to rail. Freight payable at nearest attended railway station.

SMITH'S BRASS (English) SHIPS CLOCKS
8-day, no bell, **$37.50** each. Post NSW $1.15. Interstate $1.70.

PRISMATIC COMPASSES
Genuine ex-army Mk 3, liquid damped, as new **$27.50**. Post NSW 95c. Interstate $1.15.

COLLINS TRANSCEIVERS
Auto-tuned 100-150MHz. 10 channels.

$65.00

HALF-INCH RECORDING TAPE
Top grade 2400' on 10½" reels. Ideal video experimenting. Only. $1.50 per reel.

Post N.S.W. 45c.; Interstate 75c.

LAVOIE HETERODYNE FREQUENCY METERS
10-100MHz. LA5 $250.

100-500MHz. $350.

ADLER FREQUENCY METER
100KHz 20MHz. $175.

4 DIGIT RELAY COUNTERS
50-volt DC, suit slot car. Lap counters, etc.

$1.25 each. Post 18c.

NIBBLING TOOL
Cuts sheet metal like a punch and die, trims, notches and cuts to any size or shape over 7 16-inch.

ONLY $6.50
Post 74c.

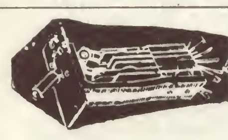
NIFE CELLS
1.2 Volt, fully charged, 4in x 3in x 1in 4 AH.

$1 each.
Post N.S.W. 25c. Interstate 35c.

3.6V 10AH, set of three batteries in wooden holder, **$7.50** per set or **$2.50** per battery 1.2 volt 10AH.

Post N.S.W. $1.10; Interstate $2.72.

COMMAND RECEIVER
Q5 190-550 K/CS. **$22.50**
6-9 M/CS **$22.50**
POST: N.S.W. $1.25, INT. $1.44



P.M.G. TYPE KEY SWITCHES.
45c each. Post 24c.

VALVES
BRAND NEW
IN CARTONS

Special discount for quality

807	75c	CV850	$1.50
65N7GT	95c	1H6G	50c
8989	$1.00	832	$5.00
5U4G	95c	6AK5	$1.50
EF50	75c	6X4	$1.00
5Y3	$1.99	12SK7	50c
6C4	50c	VR65	50c
2 x 2	75c	VT4C	75c
6AG5	80c	80	$1.25
12AU7	$1.00		

Please add postage on all articles

RADAR TRANSCEIVER
X BAND WITH KLYSTRON ETC. **$45.00**

TRANSMITTERS ARC 49
100-165 M/CS **$25.00**

TELESCOPES
50 magnification with a 60mm coated objective lens. With tripod.

$27.95
As illustrated.
Postage $1.20; Interstate $1.45.

TELESCOPES
40 x 40 with Tripod.

$7.95
Post N.S.W. 95c; Interstate $1.45

BC221
Frequency Meters.

$35.00

WALKIE TALKIES
2-way radio, 7 transistor, PMG approved, set of 2 only **$47.50**
Post NSW $1.00 9 transistor **$55.00**
Interstate $1.20

SMALL COMPUTER PANELS
3in x 2in containing 2 valves, qty. of resistors, etc.

ONLY 75c.
Post 24c.

COMMAND TRANSMITTERS
5-3-7 M/CS. **$10.00**
Post: N.S.W. $1.25 Int. $1.44

¾" Impeller pumps new gunmetal body stainless steel shaft neoprene impeller up to 15ft lift suitable for almost any type of liquid self priming dimensions approx 8" x 4" weight 5lbs. **$27.50**
Post NSW $1.20 Int. $1.90

BC348 RECEIVER **$80.00**

A.W.A. B.F.O. TYPE R7077
1-800 CYCLES
1-13 K/CS. **$30.00**

CONDENSER LENS
2½in DIAM. 2in FL. **$1.50** each. Or **$2.50** per pair. Post 24c.

AWA Distortion and noise meter type A51932 **$160.00**

522 Tranceivers
100-150 M/CS
$35.00

Cossor Double Beam Oscilloscope 1035. Tested.
$150

CHASSIS PUNCH SET
Five sizes: ⅝-inch, ¾-inch, ⅞-inch, 1-inch and 1⅛-inches. With taper reamer.

$7.50
Post, $1.15

SELSYN MOTORS MAGSLIP Mk. II .... **$5.25 ea.**
No. 19 TWO-WAY RADIOS.
Power supply, accessories, etc., **$35.**

BINOCULARS
PRISMATIC. Coated Lenses. Brand new. Complete with case.

7 x 35	$34.50
8 x 40	$37.50
7 x 50	$28.65
10 x 50	$29.60
12 x 50	$30.60
20 x 50	$34.45

Post N.S.W 95c; Interstate $1.45.

3000 TYPE RELAYS
P.M.G. 200 Ohms — 1,500 Ohm Coils. **$1.25** each. Post 24c.

TOGGLE SWITCHES
Brand new, 3 amp, 240 volt. S.P., S.T. **39c** each or 10 for **$3.**
Add postage.

Cintel Oscillator and Electronic Counter, type 388. **$250.**

SPECIAL lucky dip valve offer, 15 new valves in cartons for only **$2.** We haven't got time to sort them, so you reap the benefit.
Post 75c.

CONDENSER LENS
1½in diam. 1½FL. **50c** each.
Postage 24c.

MINE DETECTORS
Ex A.M.F. with Instruction Book. Complete in wooden case. Ideal for plumbers, councils for locating buried pipes, etc. Freight payable at nearest attended railway station. **$39.00**

BATTERY CHARGERS BRAND NEW WITH METER
plugs into 240V power and gives both 6V and 12V DC output. 4 amps with hi, medium and low charges.
Dimensions, 9" x 5" x 5"
$35 value only $27.50
Battery chargers. 1½ amps. 12V or 6V. Please state voltage required. **$15.**
Post NSW **$1.00** interstate **$1.50**

SPECIAL PURCHASE TOP GRADE RECORDING TAPES
Brand new, from well-known maker. Sorry, we cannot divulge brand name. 7" x 2,400' Mylar in plain carton.
Only **$3.50** ea. Post 35c.

SOLENOIDS
Plunger Type 12V 300MA. Suit electric camera control, miniature trains, radio. etc.
$1.25. Post 24c.
200 MA 24 volt, ⅛in push movement.
$1.25. Post 24c.

TELETYPE TELEPRINTER
11/16 inch Tape printer with keyboard
$35.00

FIELD STRENGTH METERS
144 M/CS. **$12.50**

TEN CHANNELS VHF TRANSCEIVER
Types TR 1934 100-125 MHz and TR1935 125-150 MHz. 28 volt DC operated AM single crystal locks both TX and RX on same channel complete with generator. **$33.00**

RECORDING TAPES
TOP QUALITY, BRAND NEW

		Post
3" x 150'	65c	12c
3¼" x 600'	1.58	13c
5" x 900'	1.95	13c
5" x 1800'	3.62	13c
7" x 1200'	3.18	24c
7" x 2400'	4.80	74c
7" x 3600'	6.45	74c

CASSETTE TAPES
C60 **$1.15**; C90 **$1.75**; C120, **$2.25**
Post 13c.

Crystal Earphone **75c**

Cassette head cleaners **$1.50**

Small Lapel Microphones, ea. **$1.25**
Post 24c.

DUMPY LEVELS
Made by Watts, excellent condition with tripod **$97.50**

BYER 77 Mk. 1
Rack Mounting Tape Recorder ex A.B.C. 7½-15 ips. Full track tested **$150.**

Microphone. Professional S.T.C. type 4017. **$20.**

Marconi Video Oscillator type TF885A 0-12 MHz. **$75.**

A.W.A. SIG GENERATOR
UHF 140-300 MHz **$65.00**

Pye 4 Channel Crystal Locked Oscillator, 1.5-30 MHz New. **$25**

TRANSPONDER APX6
with Lighthouse Tubes. Can be converted to 1200 MHz. **$17.**

RECEIVERS ARC 49
100-165 M/CS **$25.00**

Deitch Bros.
70 OXFORD STREET, SYDNEY 2010
SORRY, NO C.O.D.

pots on the distribution board allow it to be set up for high input levels.

The tone control system conforms to specifications, giving a boost and cut of approximately 15dB at 100Hz and 10kHz.

The Sinclair Project 605 kit is available through normal trade outlets. We are advised that the normal wholesaler/consumer price level is $75 plus 27½% sales tax. (W.N.W.)

Guitar amplifier

(Continued from page 26)

Assembly of the preamplifier control board is straightforward. Note that the shield for the HIGH input cable is not connected to the board but is connected at the socket end.

Note also that the amplifier circuitry is earthed only at the LOW input socket. Additional earth points anywhere else on the chassis will cause high hum levels and perhaps instability. The power amplifier circuit is earthed via the volume control and associated shielded cables.

Both sides of the mains are switched using a DPST switch. The transformer primary leads are terminated directly to the switch, as are the leads for the neon pilot. The switch used in the prototype was actually a DPDT type with one half unused.

The mains cord should be passed through a grommetted hole in the rear of the chassis and anchored by a clamp. This can be secured by one of the screws which hold the 8-lug tagstrip. The active leads should be taken to a terminal block, thence to the off-on switch.

Having assembled the amplifier, the unit can be switched on, with the supply lead to the amplifier disconnected. If the DC voltage across the 2200uF capacitor is more than 50 volts, the 256 volt tap in the transformer should be used instead of the 240V connection.

When this is done the supply may be connected to the amplifier. Current drain with no signal should be between 20 and 50 milliamps. If it is substantially more than this, the unit is probably oscillating supersonically. Switch off and check that your wiring is exactly the same as in the wiring diagram.

The voltage across the 2200uF output coupling capacitor should be within 1 volt of half the supply voltage, ie, if the supply is 48V the voltage across the capacitor should be between 23 and 25 volts.

Note that the 2200uF capacitor has a 50V rating. Capacitors with lower voltage ratings should not be substituted as they do not have sufficient AC current rating.

The pilot light is a neon assembly containing a limiting resistor, and is connected directly across the mains. The leads to it should be twisted and arranged as shown in the photograph and wiring diagram. In addition, a tinplate shield is arranged over the pilot assembly to stop hum radiation.

With the amplifier complete all that remains is to connect it to a suitable loudspeaker system. Many reader will have 8 to 12 inch lousdpeakers which can be pressed into service but they should be installed in an effective cabinet.

The Magnavox 8-30 with a rating of 30 watts makes an excellent guitar loudspeaker system when installed, without tweeters, in a 1.0 or 1.6 cubic feet enclosure. Cabinet details were published in January 1971. Readers may also refer to the articles we have published in the past on guitar loudspeaker systems.

Electronic whistle

(Continued from page 35)

If the reader desires to vary the ratio between rise and decay times, the TR4 emitter bypass electrolytic will mainly affect decay time. More capacitance for more decay time and vice versa. Likewise the 10uR electrolytic connected to the junction of the 1k and the 2.2k will mainly affect the rise time.

If OSC2 has been included, switch to dual horn and short the remote socket so that the whistle is on constantly. The frequency of OSC2 can be varied broadly by changing the capacitors marked with asterisks, as for OSC1, but this should only be necessary if OSC1 pitch has been altered. For fine frequency adjustment use Rv1. The dual horn sound can now be adjusted to suit your impression of how it should sound by adjusting the frequency of OSC2. Normally this frequency will be correct when there is minimum low frequency beat discernible in the output. The output of OSC2 can be varied by changing the 2.2M in series with the .022uF coupler, but again this should only be necessary if OSC1 output has been changed.

The unit may be triggered remotely by any suitable means, using the remote socket. It could be triggered by placing a reed switch between the rails, and a permanent magnet under the loco. This arrangement would require a suitable holding circuit to maintain the whistle for a short period after the pulse occurs.

NOTES AND ERRATA

AF WHITE NOISE GENERATOR (July 1972, File No. 7/N/6): We have had inquiries from readers re suppliers of IC2 (SS6-1032). A reference to this on page 224 of the May 1972 issue of Wireless World says: This is made by General Instrument Micro-electronics. A plastic packaged version, the SS-7-1032, is now available. This is electrically identical but cheaper. Both devices are available from S.D.S. (Portsmouth) Ltd, Hilsea Industrial Estate, Portsmouth, Hants, PO3 5JW, England.

CONTROL CENTRE FOR AMATEURS (August 1972 File No. 1/M/14): We have been advised by STC that the relay type 250-AKO has been superseded by the type 250-AMO and that although supplies of the 250-AKO relays may be still available, the type 250-AMO is preferred for ordering. The 250-AMO differs from the 250-AKO only in terms of coil resistance — 185 ohms instead of 230 ohms — and no change to the circuit is required when the 250-AMO is used.

PLAYMASTER 135 PA AMPLIFIER (September 1972, File No. 1/PA/30): In the parts list on page 31, the Fairchild silicon power kit should include a type 2N4250 device.

SAFE-T-PLUG. (September 1972, File No. 2/MS/22): In the text on page 80, one of the paragraphs begins "If lamps A & B glow, . . ." This should read "If lamps B & C glow . . ." The SAFE-T-PLUG label is correct. The miniature neon bulbs type T2, are available from Circuit Components A'asia, PO Box 70, Bexley 2207.

MARKETPLACE

FOR SALE

WE SELL construction plans. TELEVISION: 3 D converter, $25 camera, Kinescoping recorder, VTR, COLOUR CONVERTOR. HOBBYIST: Electron microscope, 96-hour music system, voice type writer, Morse code to typewriter, Morse code to typewriter copier, transistorised teletype. TELEPHONE: Answering machine, pushbutton dialer, phonevision, auto-dialer, telephone extension in your automobile, legal connector. SECURITY: Microphone jammer, voice scrambler, microdot photography. Plans $5.00, air shipped from our USA research labs. COURSES: Telephone engineering $39.50, security electronics $27.50, investigative electronics $22.50. Super hobby catalogue air mailed $1.00. Payment accepted in dollars (Australian, New Zealand or US). Don Britton Enterprises, Suite 28, 280 Pitt Street, Sydney, Australia.

HI-FI equipment. We import famous Lowther speakers and Class A amplifiers for music lovers who want the best. We also stock Quad, Goodmans, Dual, Jordan-Watts, Tandberg, Revox, Sony, Sansui, AWA, Wharfedale, Thorens, Decca, Ribbon tweeters, etc, etc. Encel Hi-Fi. For superb fidelity, Duratone, Mail Order, PO Box 125, Curtin, ACT. Demonstrations, phone Canberra 81 2549.

BACK Issues Electronics Australia stocked, 50c each, prompt service, post free. T. Weir, 56 O'Connor Street, Haberfield, NSW 2045. Phone Sydney 798 7569. Wanted to buy copies also.

CCTV EQUIPMENT. One Fernseh "Plumbicon" camera — almost new, with or without lens, head and tripod; otherwise complete (tube, cable, etc) Approx $3,000.
Two Ampex VTRs — one 5103, one 5103 E less than a year old. $900 and $2,000 resp.
All in excellent condition, maintained by full-time technician. Further information 347-5122 (bus hours) 848-5892 (private) STC, PARKVILLE, VICTORIA.

COLLECTION of drawings TV circuits, different brands, new & old models. Also valve checker. Offers to Abel Resoagli, 8 Owen St., PUNCHBOWL, NSW 2196.

MOVING coil meter and multimeter repairs send or deliver to Anderson Electronics, 35 Abercoen St, Bexley, NSW, 2207. 506526.

SERVICE

BILL TURNBULL offers you service on Hi Fidelity equipment tape Recorders, Communication Receivers and Electronic Test Equipment.

All work guaranteed

BILL TURNBULL

11 ELLALONG ROAD, CREMORNE, N.S.W. 90 4825

RESISTORS, ½W, only 3.5c each, 1W only 6c; P/M kits, complete to last screw, 128 — $88; 127 — $96; 132 — $145; prices for other P/M kits on application; all parts available for P/M 132, send for free list. BC 107/8/9 — 40c each; stereo speaker lead, good quality, 6c/yd; single mic cable 14c/yd; double 28c/yd; 5 & 3 pin din plugs, white or grey 44c, sockets 30c; RCA plugs 10c; RCA sockets 10c; anti-static record cleaner with free cloth $1.90; EM401 30c; BZY88 zeners, C3V3 — C12, 55c; C13 — C30, 65c; BZX70 zeners, C10 — C75, $1.25; 2N3055 — $1.55; 2N3053 — $1.23; 2N301 — $2.10; OC44N — 50c; send for free catalogue. P & P 15c, $10 plus free. Full range 100v, 400v, 630v, 500v, ceramic and polyester capacitors available. Hilltop Electronics, 21 Hilltop St, GEELONG, VIC., 3218.

— SURPLUS EQUIPMENT FOR SALE — Of Interest To The Radio Enthusiast. NO REASONABLE OFFER REFUSED. Gates "Sta-Level" Amplifier (type M5167). AWA Limiting Amplifier (type G51501). AWA Power Supply (type H8027). AWA Studio Consolette (type G52107). AWA Monitor Amplifier and Power Supply (type G52108). Two AWA Ribbon Microphones (type 44BX) just checked and serviced by AWA. Ferrograph "Series five" half track Tape Recorder (speeds 3¾ & 7½). Byer "66" full track Tape Recorder (speeds 3¾ & 7½). Fi-Cord "model 1A" Portable Tape Recorder (speeds 1 7/8 & 7½). Two brand new Ferguson Stepdown Transformers (240/115 volts — 260m/a). WHAT OFFERS FOR ANY OR ALL OF THE ABOVE. All enquiries to: The Manager, Radio 4VL, CHARLEVILLE, Q'ld, 4470.

GELOSO AC Tape Recorder G255S. Palec VCT, LATER MODEL. Ferrocart VTVM PV33. Tech VTVM PV58. Palec Mod — osc. MO1. PC with books of acc. $19 each. Philips Bar-dot Gene. GM2891 PC $29. O'Brien, Edgar Rd, San Remo, Vic. Ph 107.

TV and ELECTRICAL Retail and Service business in NW Vic country town. Stock and plant at valuation. Established clientele WI-WO. Reply 8743 ELECTRONICS AUSTRALIA.

ELECTRONIC JOURNAL

Electronic, Hi-Fi, Radio Journals a good variety always on sale . . .
We would be pleased to reserve any particular magazines for you.

FRANK MATHIAS NEWSAGENT
715 George St., Sydney 211-5003

ORGAN SERVICE
SOLE SUPPLIERS
TOSHIBA ORGAN SPARE PARTS

ERIC ANDERSON'S
49 VICTORIA ST., ALEXANDRIA, N.S.W. 2015. PHONE 69 6621

DISPLAY ADVERTS in MARKETPLACE are sold in multiples of one inch to a maximum of five inches. Rate $10.00 per inch per insertion, subject to continuity discounts.

CLASSIFIED RATES $1.00 per line per insertion payable in advance. Minimum two lines. A convenient form is provided in each issue.

CLOSING DATE is four weeks prior to the on-sale date. Issues are on-sale the first Monday of each month.

ADDRESS all classified orders, copy, enquiries, etc. to: The Advertising Manager, ELECTRONICS Australia, Box 2728 G.P.O., Sydney 2001.

BRENELL MK5, series 3, 4 track 3 head Tape Deck and Amplifiers $110. R. Thompson, Box 117, COBAR 2835. Ph COBAR 2.

PRICE DROP. SN7490N IC $1.90 each plus 20c post. 5 for $1.80 each, post free. 24 hour despatch, with free data sheets. DFI SERVICES, Dept A, PO Box 188, BLACKWOOD, SA 5051.

"FINNED EXTRUDED ALUMINIUM HEAT-SINKS/BOXES". Use as heatsinks or two mating sections form a sealed box, internal racks are provided to mount PC boards, etc, easily dismantled and ideally suitable for CDI units, amplifiers, inverters, etc. Available in plain or anodised in two sizes: (a) L4" x W4" x D3" at $1.95 or (b) L6" x W4" x D3" at $2.30. Anodised — Red, Blue or Gold (State 1st & 2nd choice) — (a) at $2.35, (b) at $2.75. For Black Finish add 10c. P & P for up to two boxes 50c. PC boards — fibreglass 6" x 3" at 30c — P & P 10c. Oil filled capacitors, 1.0 mfd 1000 volt test —$1.85 suit CDI. P & P 25c. Mail orders processed within 2 days. Send cheques and Money Orders to: — HPH ELECTRONICS, PO BOX 15, LIVERPOOL, NSW, 2170.

COMPAX III Turntable, Micro Arm, Shure M75E Cartridge $75. SYDNEY, 38-1575.

SUPER BARGAIN SPECIALS FROM MICRONICS

For this month only! ! !
POLYESTER CAPS, Top Grade: .0022uF/400V-1c ea., .001uF, .0039uF (400V)-3c ea., 0.47uF/200V-10c ea. or 10 for 80c or 100 for $5.00.
ELECTROLYTICS, top quality (Pigtails): 4uF/25V, 2.5uF/64V, 8uF/100V, 47uF/10V — 5c ea., 1500uF/10V, 470uF/25V — 20c ea., 1000uF/25V — 35c ea.
STYROSEALS (Top Brand): .0022uF/200V, 47pF, 220pF (630V) — 5c ea.
CERAMIC DISC CAPS: .0027uF/500V — 3c ea. or 100 for $2.00, 1.8pF, 2.2pF, 3.3pF, (500V) — 3c ea.
CERAMIC TUBULAR CAPS (500V): 15pF, 18pF, 33pF — 3c ea.
RESISTORS: Bag of 100 mixed — $1.00.
SWITCHPOTS: 50k(c) — 30c ea.
TAB POTS (Chassis mount): 5k(a) — 15c ea. Bank of 4 Push Button Switches (Push on, Push off) — 50c.
ZENER DIODES BZY88(6V2) — 40c ea.
COPPER CLAD BOARD 6"x3" — 10c. **FERRIC CHLORIDE ETCHANT** (Solid) 100 grm bag 40c.
RESISTORS — Carbon Film, ½w, 5%. High stability, E.12 values 10-10M 4c ea. **POLYESTER** FILM CAPACITORS SUBminiature "GREENCAP". Top Quality. 100VW: .001, .0015, .0022, .0033, .0039, .0047, .0056, .0068, .0082, .01, .015, .022-10c ea., .033, .039-12c ea., .047, .056-14c ea., .068, .082-16c ea., .1-18c, .15-20c, .22-22c.
ELECTROLYTICS — High stability, miniature, single ended, 25VW: 4.7uF-15c, 10uF-17c, 25uF-19c, 47uF-21c, 100uF-24c, 220uF-28c, 470uF-38c, 1000uF-58c 50VW: 4.7uF-18c, 10uF-21c, 25uF-23c, 47uF-25c, 100uF-30c, 220uF-42c, 470uF-70c. **PRE-SET POTS** — Miniature (10mm). Range 500, 1k, 2k, 5k, 10k, 25k, 50k, 100k, 250k, 500k, 1M, 2M only 20c ea. **TANTALUM** Capacitors, Miniature, Single ended. ELNA type: 0.1uF, .47uF, 1uF, 2.2uF, 3.3uF, (35V), 4.7uF, 6.8uF(25V), 10uF(16V), 15uF(10V), 22uF(6.3V) — all 35c ea.
CERAMIC CAPACITORS SUBminiature — Top Quality 50VW: 220pF, 330pF, 470pF, .001, .002, .005, .01, .02uF — 6c ea. .03, .04, .05uF — 7c ea. Post Pack 20c. **MICRONICS,** P.O. Box 175, Randwick, N.S.W. 2031.

ELECTRONICS Australia

Guarantee yourself a complete set of issues for your library with no copies missing.

POST THIS COUPON TO:
Subscription Department, ELECTRONICS Australia, Box 506, G.P.O., Sydney 2001, Australia.

Name ....

Address ....

Enclosed is $...... for ...... years. Start with ....

Subscription Rates

Australia
New Guinea,
New Zealand
$6.50 per year

Elsewhere
$9.00 per year

Reader Information Service

Here is a convenient and easy way for you to get additional information about products or services advertised in this issue. Just fill out the coupon stating the information you require, cut out the coupon and post to:

Reader Information Service, ELECTRONICS AUSTRALIA, Box 2728, G.P.O., Sydney 2001.

Note: Please list only one advertiser and one product on each coupon.

Post to: **ELECTRONICS AUSTRALIA. Box 2728 GPO, Sydney 2001**

Advertiser .... Page ......

Product ....

Your Name ....

Address ....

.... Postcode ....

Position & Company 10/72

Post to: **ELECTRONICS AUSTRALIA, Box 2728 GPO, Sydney 2001**

Advertiser .... Page ......

Product ....

Your Name ....

Address ....

.... Postcode ....

Position & Company 10/72

CLASSIFIED ADVERTISERS

To the Advertising Manager, ELECTRONICS Australia, Box 2728 G.P.O., Sydney. 2001

- Please insert the following advertisement in the .... issue
- Tick the classification required

☐ FOR SALE ☐ WANTED ☐ READER SERVICE ☐ POSITIONS

Please write in block letters with ink or ball-point pen. **Number of insertions** ....

Signed: ....

Residential Address ....

.... State ....

- I enclose P. Note / Cheque for $.... being full payment for .... lines at $1.00 per line. (minimum 2 lines)

Index to Advertisers